Technical Standard 014

General Requirements for Customer Equipment Connected to an ISDN Primary Rate Interface

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FOREWORD

General

The ACA has made this Technical Standard under Section 376 of the Telecommunications Act 1997. This Technical Standard is a disallowable instrument for the purposes of section 46A of the *Acts Interpretation Act 1901* and may be cited as ACA TS 014 – 1997.

This Technical Standard incorporates relevant provisions from applicable international, regional and domestic standards.

The requirements in this Technical Standard are consistent with the aims of Section 376 of the *Telecommunications Act 1997*. Specifically these aims are:

(a) Protecting the integrity of a telecommunications network or facility; and

(b) Protecting the health and safety of persons; and

(c) Ensuring access to emergency services; and

(d) Ensuring interoperability with a standard telephone service.

This Technical Standard specifies the minimum requirements for Customer Equipment (CE) to connect to Telecommunications Network via an Integrated Services Digital Network (ISDN) primary rate access interface, at the 'T' reference point, as well as conformance testing procedures for testing the compliance of the CE to this Technical Standard.

Compliance with this Technical Standard ensures that CE will not adversely affect the integrity of the ISDN and ensures a minimum level of interoperability between the CE and the ISDN. This minimum level of interoperability covers the following demand–established bearer services in accordance with ITU–T (formerly CCITT) Rec. I.231 [30]:

(a) circuit–mode 64 kbit/s unrestricted, 8 kHz structured bearer service;

(b) circuit–mode 64 kbit/s, 8 kHz structured bearer service useable for speech information transfer;

(c) circuit–mode 64 kbit/s, 8 kHz structured bearer service useable for 3.1 kHz audio information transfer.

This Standard does not mandate that CE implement procedures to support these services, but does require that where these services are supported then the associated customer access interface protocols are to be implemented in accordance with this Standard.

This Technical Standard is based on a significant amount of the material from a number of ITU–T (formerly CCITT) Recommendations. Some of this material is based on the ITU–T Red Book Recommendations and contains modifications, plus Australian generated material. Thus it is not practical to attempt to correlate the content against that of the relevant later edition ITU–T Recommendations in order to achieve a ready indication to the reader as to what is the original ITU–T material. However it should be noted that this Technical Standard is migrating towards being more internationally based and in line with recent ITU–T Recommendations.

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2 INTERPRETATIVE GUIDELINES

2.1 Categories of Requirements

This Technical Standard contains mandatory requirements as well as provisions that are recommendatory only. Mandatory requirements are designated by the words '**shall**' or '**shall not**'. All other provisions are voluntary.

2.2 Compliance Statements

Compliance statements, in italics, specify methodologies for demonstrating CE's compliance with the mandatory requirements.

2.3 Definitions, Expressions and Terms

If there is any conflict between the definitions used in this Technical Standard and the definitions used in the *Telecommunications Act 1997*, the definitions in the Act take precedence.

2.4 Notations

2.4.1 Hexadecimal numbers are written as:

Nh, NNh or NN–NNh, where N is a hexadecimal digit (0 to 9, A to F).

2.4.2 Binary numbers are written as:

$BBBBBBBB_2$, where B is a binary digit (0 or 1).

2.5 Notes

Text denoted as 'Note' is for guidance in interpretation and is shown in smaller size type. Notes associated with tables and figures may contain mandatory requirements.

2.6 **References**

2.6.1 Applicable editions (or versions) of other documents referred to in this Technical Standard are specified under the REFERENCES.

2.6.2 If a document refers to another document, the other document is a sub-referenced document.

2.6.3 Where the edition (or version) of the sub-referenced document is uniquely identified in the reference document, then that edition (or version) applies.

2.6.4 Where the edition (or version) of the sub-referenced document is not uniquely identified in the reference document, then the applicable edition (or version) is that which is current at the date the reference document comes into effect .

2.6.5 A number in square brackets '[ ]' refers to a specification or standard listed in the REFERENCES.

2.7 **Units and Symbols**

In this Technical Standard the International System (SI) of units and symbols is used in accordance with Australian Standard AS 1000 [5].

3 SCOPE

3.1 This Technical Standard identifies the minimum requirements for connection of Customer Equipment (CE) to a Telecommunications Network via the Integrated Services Digital Network (ISDN) Primary Rate Access Interface.

3.2 Sections 5.2, 5.3 and 5.4 of this Technical Standard, with the exception of those parts dealing with compliance with international standards, are based on draft ITU–T I.400 series Recommendations at the time of publication as follows:

ITU–T Red Book (Geneva, 1985)

Vol III – Fasc. III.s.

Layer 1: Rec. I.431 [35], pages 178 to 184

Layer 2: Recs. I.440 [36] and I.441 [37], pages 187 to 237 (which are equally published in the Red Book Vol. VI – Fasc. VI–9, Recs. Q.920 [46] and Q.921 [47], pages 3 to 53).

Layer 3: Recs. I.450 [38] and I.451 [39], pages 241 to 380 (which are equally published in the Red Book Vol. VI – Fasc. VI. 9, Recs. Q.930 [48] and Q.931 [49], pages 54 to 193).

Vol. III – Fasc. III 3

Recs. G.703 [19] and G.704 [20], pages 44 to 80.

3.3 Departures of this Technical Standard from the definitive 1988 I-series ITU–T Recommendations are separately identified in Clause 7, Compliance with International Standards, of this Technical Standard.

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4 Abbreviations and Technical Definitions

4.1 Abbreviations

ACA	Australian Communications Authority
Ai	Action Indicator
AIS	Alarm Indication Signal
ASP	Assignment Source Point
B	B–Channel
CE	Customer Equipment
CEI	Connection Endpoint Identifier
CES	Connection Endpoint Suffix
CME	Connection Management Entity
C/R	Command/Response
CRC	Cyclic Redundancy Check
D	D–Channel
DDI	Direct Dial In
DISC	DISConnect
DL–primitive	Primitive between Layer 3 and Data Link Layer
DLCI	Data Link Connection Identifier
DM	Disconnect Mode
EA	Extended Address field bit
ET	Exchange Termination
HDLC	High–level Data Link Control
HLC	High Layer Compatibility
HLF	High Layer Function
I	Information
IA5	International Alphabet No. 5
ID	IDentity
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardisation L1 Layer 1
ITU–T	International Telecommunications Union Technical (formerly CCITT International Telegraph and Telephone Consultative Committee)
L2	Layer 2
L3	Layer 3
LAPD	Link Access Procedure on the D–Channel
LLC	Low Layer Compatibility
LLF	Low Layer Function
LME	Layer Management Entity
LSB	Least Significant Bit
LT	Line Termination
M	Modifier function bit
MDL–primitive	Primitive between Management entity and Data Link Layer
MSB	Most Significant Bit
NIC	Network Independent Clock
NSAP	Network Service Access Point
NT1	Network Termination 1

NT2	Network Termination 2
OSI	Open System Interconnection
P/F	Poll/Final
PH–primitive	Primitive between Data Link Layer and Physical layer
REJ	REJect
Ri	Reference number
RNR	Receive Not Ready
RR	Receive Ready
S	Supervisory function bit
SABME	Set Asynchronous Balanced Mode Extended
SAP	Service Access Point
SAPI	Service Access Point Identifier
SDU	Service Data Units
SI	International System
SMF	Submultiframe
TE	Terminal Equipment
TEI	Terminal Endpoint Identifier
U	Unnumbered
UA	Unnumbered Acknowledgment

4.2 Technical Definitions

4.2.1 Active (U10)

A state which exists when a call is in the end–to–end communication mode.

4.2.2 B Channel

A 64 kbit/s channel that carries customer information such as voice, circuit switched or packet switched data (refer ITU–T Rec. I.412 [34]).

4.2.3 Call Delivered (U4)

A state which exists for an outgoing call, when calling user has received an indication that remote user alerting has been initiated.

4.2.4 Call Init (U1)

A state which exists for an outgoing call, as a result of CE action requesting call establishment.

4.2.5 Call Present (U6)

A state which exists when an incoming call is awaiting a response from the CE to the call SETUP message from the network.

4.2.6 **Call Received (U7)**

A state which exists for an incoming call when a response from the called CE is awaited while alerting.

4.2.7 **Connect Request (U8)**

A state which exists for an incoming call while awaiting receipt from the network of a connect acknowledgment.

4.2.8 **Carriage Service Provider**

Refer *Telecommunications Act 1997.*

4.2.9 **Carrier**

Refer *Telecommunications Act 1997.*

4.2.10 **Customer Switching System (CSS)**

Any switching system connected to a Telecommunications Network that can switch voice, digital data, images, video or any other information and is capable of performing NT2 functions.

4.2.11 **Customer Equipment (CE)**

Refer *Telecommunications Act 1997.*

4.2.12 **D Channel**

A 64 kbit/s channel carrying signalling and CE–to–CE information (refer ITU–T Rec. I.412 [34]).

4.2.13 **Disconnect Request (U11)**

A state which exists in response to a request by the CE to disconnect a call, prior to acknowledgment by the network.

4.2.14 **Disconnect Indication (U12)**

A state which exists when the network has indicated disconnect and the CE has not yet indicated release or detach.

4.2.15 **Entity**

An active element within a layer which may comprise of one or more processes.

Note: These processes together perform the functions of the entity.

4.2.16 **Facility**

Refer to Section 374(2) of the *Telecommunications Act 1997*.

4.2.17 **Incoming Call Proceeding (U9)**

A state which exists for an incoming call when the CE has acknowledged receipt of the information required for the call to proceed and the network is awaiting further CE response.

4.2.18 **Implementation Under Test (IUT)**

That part of a real open system which is to be studied by testing, which should be an implementation of one or more OSI protocols in an adjacent CE–provider relationship.

4.2.19 **Manager**

Refer to Section 375 of the *Telecommunications Act 1997*.

4.2.20 **Null State (U0)**

A state where no call exists.

4.2.21 **Outgoing Call Proceeding (U3)**

A state which exists for an outgoing call when the network has acknowledged receipt of the information required for the call to proceed and the CE is awaiting further network response.

4.2.22 **Overlap Sending (U2)**

A state which exists for an outgoing call while the CE is sending call set–up information to the network in the overlap mode.

4.2.23 **Port**

An interface to equipment for the purpose of supplying an output signal and/or accepting an input signal.

4.2.24 **Protocol Implementation Conformance Statement (PICS)**

A statement made by the supplier of an OSI implementation or system, stating the capabilities and options which have been implemented, and any features which have been omitted.

4.2.25 **Protocol Implementation Extra Information for Testing (PIXIT)**

A statement made by a supplier or implementor of an IUT which contains, or refers to, all of the information (in addition to that given in the PICS) related to the IUT and its testing environment, which will enable the test operator to run the appropriate test suite against the IUT.

4.2.26 **Release Request (U19)**

This state exists in response to a user release request prior to acknowledgement by the network

4.2.27 **System Under Test (SUT)**

The real open system in which the IUT resides.

4.2.28 **Telecommunications Network**

Refer to Section 374(1) of the *Telecommunications Act 1997*.

4.2.29 **Test Case**

A generic, abstract or executable test case.

4.2.30 **Test Event**

An indivisible unit of test specification at the level of abstraction of the specification (e.g. sending or receiving a single PDU).

4.2.31 **Test Group**

A named set of related test cases.

4.2.32 **Test Step**

A named subdivision of a test case, constructed from test events and/or other test steps, and used to modularise an abstract test case.

4.2.33 **Test Suite**

A complete set of test cases, possibly combined into nested test groups, that is necessary to perform conformance testing or basic interconnection testing for an IUT or protocol within an IUT.

4.2.34 **User**

Customer Equipment.

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5 REQUIREMENTS

5.1 General

5.1.1 Safety

ACA Technical Standard 001 [1] specifies safety requirements for equipment intended for connection to a Telecommunications Network (TN).

Note: CE must satisfy applicable safety requirements of ACA Technical Standard 001 [1].

5.1.2 Fail–Safe Operation

5.1.2.1 CE **shall not** cause harm or damage to a Telecommunications Network or Facility if any of the following events, or a consequential event, occurs:

(a) failure of any single mechanical or electrical component in the CE; or

(b) failure of any power supply (including AC mains voltage and local battery) to the CE; or

(c) incorrect manual operation of the CE.

5.1.2.2 CE should not cause harm or damage to a Telecommunications Network or Facility when CE is operated outside the range of operating voltage and environmental conditions specified by the manufacturer.

5.1.2.3 When the battery voltage of battery-powered CE varies, the CE **shall** fail safe before causing any harm to a Telecommunications Network or Facility.

Note: This clause is intended to preclude out-of-specification operation, due to battery discharge, when such operation threatens network integrity.

*Compliance with Clause 5.1.2 **shall** be checked by inspection and operation.*

5.1.3 Emergency Calling

5.1.3.1 CE capable of establishing speech circuits **shall** support emergency number '000' dialling.

5.1.3.2 CE capable of establishing speech circuits, should not support barring of access to emergency number '000'.

5.1.3.3 Mains powered CE capable of establishing speech circuits, should continue to support emergency number '000' dialling for at least 30 min following loss of mains power.

Note: CE that does not continue to support emergency dialling after loss of mains power, should include in the accompanying documentation a warning notice. A suggested wording for such a warning notice is as follows:

Warning
This equipment will be inoperable when mains power fails

Compliance with Clause 5.1.3 ***shall*** *be checked by operation and inspection.*

5.1.4 Operating Voltage and Environmental Conditions

5.14.1 CE should comply with this Technical Standard under all conditions of ambient temperature between 0°C and 45°C and humidity between 10 and 95% RH or associated environmental conditioning.

5.1.4.2 All mains–powered CE, including those with a separate but associated power supply, should operate normally with supply voltage variations of up to +10% and –15%, from the nominal 240 V 50 Hz supply. The CE should also be safe to operate when subjected to this range of supply variation.

5.1.4.3 All non–mains powered CE should operate normally over the power supply range specified by the supplier.

Compliance with Clause 5.1.4 should be checked by inspection and operation.

5.1.5 Line Polarity and Line Conductor Polarisation

The operation of the CE **shall** be independent of:

(a) line conductor polarisation for balanced pair interfaces, i.e. the connection of specific conductors of the line pair to specific line terminals of the CE; and

(b) the polarity of any voltage on any specific line conductor.

Compliance with Clause 5.1.5 ***shall*** *be checked by inspection and operation.*

5.1.6 Emission of Electromagnetic Interference

Electromagnetic emission standards identified in the EMC Framework impose limits on radiated and conducted emission levels for telecommunications equipment.

Note: CE must satisfy applicable electromagnetic emission standards identified in the EMC Framework.

5.1.7 Voice Frequency Performance

Digital telephones and other CE providing acoustic interfaces to the digital bit stream **shall** comply with ACA Technical Standard 004 [2]. The Send and Receive Loudness Ratings, Frequency Response and the Sidetone Masking Rating **shall** be

measured using a test codec and the method described in ACA Technical Standard 004 [2].

*Compliance with Clause 5.1.7 **shall** be checked in accordance with ACA Technical Standard 004 [2].*

5.2 Layer 1

5.2.1 General

5.2.1.1 This section details requirements for the layer 1 electrical, format and channel usage characteristics of the primary rate (2048 kbit/s) CE interface at the T reference point.

5.2.1.2 This section identifies the alternatives adopted from those options given in ITU–T ITU–T Recs. I.431 [35], G.703 [19], G.823 [28] and others and should be read in conjunction with these and other specifications.

5.2.2 Configuration

The CE interface at the T reference point **shall** only support the point–to–point configuration as described in ACA Technical Standard 016 [4].

*Compliance with Clause 5.2.2 **shall** be checked in accordance with ACA Technical Standard 016 [4].*

5.2.3 Interfaces

All CE interfaces ports which are capable of being connected to a telecommunications network **shall** comply with the requirements of ACA Technical Standard 016 [4].

*Compliance with Clause 5.2.3 **shall** be checked in accordance with ACA Technical Standard 016 [4].*

5.2.4 Pair connections

The CE **shall** provide two symmetrical pair connections:

(a) one for digital transmission from the CE; and

(b) one for digital transmission to the CE.

Note: The use of HDB3 coding removes the need to provide separate synchronisation connections.

5.2.5 Line Connections

5.2.5.1 All CE **shall** terminate on:

(a) an insulation displacement system frame; or

(b) a plug which complies with the requirements of ACA Technical Standard 008 [3] and is one of the following types:

(i) A plug type as defined in AS/NZS 4102 [7] (eight position);

Note: The plug type defined in AS/NZS 4102 [7] is equivalent to the types defined in ISO/IEC 10173 [16] and FCC 68 [8].

(ii) a coaxial cable plug or socket complying with ACA Technical Standard 008 [3] and in accordance with DIN 47295 Type A (screw coupling).

Note: Telecommunications Network services will terminate on one of the following connectors (refer to AS 3080 [6] for pair/pin assignments for FCC 68 [8] (eight position) type plug and sockets):

(i) Insulation displacement or solder termination MDF.
(ii) Socket Type FCC 68 [8] (eight position).
(iii) Coaxial cable 75 •.
(iv) Female socket in accordance with DIN 47295 Type A (screw coupling).

5.2.6 **Powering**

Power feeding **shall not** be available in either direction across the CE interface.

Compliance with Clause 5.2.6 ***shall*** *be checked by operation and inspection.*

5.2.7 **Timing Functions**

5.2.7.1 Timing signals **shall** provide a co–directional interface.

5.2.7.2 The CE **shall** derive its timing in accordance with the requirements of ACA Technical Standard 016 [4].

5.2.7.3 In the event that the CE cannot synchronise with the network for any particularreason, for example loss of received signal, the CE **shall** continue to transmit frames using an internal clock and **shall** set an alarm bit.

Compliance with Clause 5.2.7 ***shall*** *be checked in accordance with ACA Technical Standard 016 [4].*

5.2.8 **Bit Rate**

The bit rate of the 2048 kbit/s primary rate CE interface **shall** comply with the requirements of ACA Technical Standard 016 [4].

Compliance with Clause 5.2.8 ***shall*** *be checked in accordance with ACA Technical Standard 016 [4].*

5.2.9 **Line Coding**

The CE **shall** be capable of receiving and transmitting High Density Bipolar Code of order 3 (HDB3) in accordance with the requirements of ACA Technical Standard 016 [4].

Compliance with Clause 5.2.9 ***shall*** *be checked in accordance with ACA Technical Standard 016 [4].*

5.2.10 Frame Structure

5.2.10.1 Number of bits per time slot

The number of bits per time slot **shall** be equal to 8 and the CE **shall** transmit and receive bit 1 first.

Note: In Tables and Figures the bits are numbered from 1 to 8 with bit 1 being shown on the right hand side.

5.2.10.2 Number of time slots per frame

The number of time slots per frame **shall** be equal to 32, thus giving rise to 256 bits per frame. The time slots **shall** be numbered from 0 to 31 and the frame repetition rate **shall** be 8000 frames/s.

Table 1
Allocation of Bit Numbers 1 to 8 of Time Slot 0 of the Frame

Bit number	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Even numbered frames (Frame containing the frame alignment signal)	1	1	0	1	1	0	0	Y Note 1
	<-------Frame Alignment Signal------->							
Odd numbered frames (Frame not containing the frame alignment signal)	F	E	D	C	B	A Note 3	1 Note 2	Z Note 1
	<-----------Note 4---------->							

Note 1: The use of bits Y and Z is defined in Appendix A.

Note 2: This bit is fixed at 1 to assist in avoiding simulations of the frame alignment signal.

Note 3: The use of this bit is defined in Clause 5.2.14.

Note 4: The use of these bits is defined in Clause 5.2.15.

5.2.10.3 Time Slot Assignment

5.2.10.3.1 Time Slot 0

Time slot 0 has two basic formats which are predicated on whether the frame is an even numbered or an odd numbered frame. The structure of each type of frame **shall** comply with Table 1.

5.2.10.3.2 **Frame Alignment Signal (FAS)**

5.2.10.3.2.1 The FAS **shall** occupy bit positions 2 to 8 of time slot 0 of every even numbered frame (refer Table 1) and **shall** conform to the bit pattern illustrated in Table 1.

5.2.10.3.2.2 In order to avoid simulation of the FAS in bits 2 to 8 of time slot 0 in frames not containing the FAS, bit 2 in those time slots **shall** be fixed to 1.

5.2.10.3.3 **D–Channel**

Time slot 16 **shall** be assigned to the D–Channel for signalling. CE **shall** only accept signalling information in time slot 16 and **shall** only transmit signalling information in time slot 16.

5.2.10.3.4 **B–Channels**

Time slots 1 to 15 and 17 to 31 are available for allocation as B–Channels. Time slots 1 to 15 **shall** be allocated as B channels numbered 1 to 15 respectively and time slots 17 to 31 **shall** be allocated as B channels numbered 16 to 30 respectively. CE **shall** only transmit and receive information in these time slots.

5.2.10.4 **Frame Alignment Procedures**

5.2.10.4.1 Frame alignment **shall** be assumed to have been lost when three consecutive frame alignment signals have been received with an error.

5.2.10.4.2 Frame alignment **shall** be assumed to have been recovered when the following sequence is detected:

(a) for the first time, the presence of the correct frame alignment signal;

(b) the absence of the frame alignment signal in the following frame, detected by verifying that bit 2 in time slot 0 is still set to 1; and

(c) for the second time, the presence of the correct frame alignment signal in the next frame.

5.2.10.4.3 As an alternative to the procedure described in Clause 5.2.10.4.2, when a valid frame alignment signal is detected in frame n, a check **shall** be made to ensure that a frame alignment signal does not exist in frame n + 1, and that a frame alignment signal exists in frame n + 2. Failure to meet one or both of the requirements for frames n + 1 and n + 2 **shall** cause a new search for a valid frame alignment signal to be initiated in frame n + 2.

Note: This procedure may be used to avoid the possibility of a state in which no frame alignment can be achieved due to the presence of an imitative frame alignment signal.

5.2.11 **Output Signal Characteristics**

5.2.11.1 **Pulse Shape**

The pulse shape at the CE interface output port **shall** comply with the requirements of ACA Technical Standard 016 [4].

5.2.11.2 **Impedance**

The impedance of the output port **shall** comply with the requirements of ACA Technical Standard 016 [4].

Compliance with Clause 5.2.11 ***shall*** *be checked in accordance with ACA Technical Standard 016 [4].*

5.2.12 **Input Signal Characteristics**

5.2.12.1 **Pulse Shape**

The pulse shape at the input port **shall** comply with the requirements of ACA Technical Standard 016 [4].

Compliance with Clause 5.2.12.1 ***shall*** *be checked in accordance with ACA Technical Standard 016 [4].*

5.2.12.2 **Return Loss and Signal / Noise Immunity**

The return loss and signal noise immunity characteristics at the input port **shall** comply with the requirements of ACA Technical Standard 016 [4].

Compliance with Clause 5.2.12.2 ***shall*** *be checked in accordance with ACA Technical Standard 016 [4].*

5.2.12.3 **Jitter and Wander**

Equipment **shall** operate without degradation of performance when receiving signals modulated with sinusoidal jitter in accordance with ACA Technical Standard 016 [4].

Compliance with Clause 5.2.12.3 ***shall*** *be checked in accordance with ACA Technical Standard 016 [4].*

5.2.13 **Operations and Maintenance**

5.2.13.1 **Alarm Indication Signal**

5.2.13.1.1 When an Alarm Indication Signal (AIS) is transmitted across the CE interface the AIS **shall** correspond to a continuous binary 1 condition, which overrides all frame alignment, signalling and other signals.

Note: Fault conditions which initiate an AIS are usually given in the relevant equipment specifications.

5.2.13.1.2 An all 1s condition may also exist within a single time slot. If this condition should occurs, the CE **shall not** respond to the condition.

5.2.13.2 **Cyclic Redundancy Check Procedure**

5.2.13.2.1 The CE **shall** implement a cyclic redundancy check procedure for information sent across the interface in both directions.

5.2.13.2.2 Bits Y and Z of Table 1, being the first bit of each even and odd numbered frames respectively, **shall** be used for a four bit cyclic redundancy check (CRC–4) procedure as described in Appendix A.

Note: For additional information refer to ITU–T Rec. G.704 [20] Section 2.3.3.

5.2.13.3 **CRC Multiframe Alignment Procedure**

5.2.13.3.1 The CE **shall** only achieve a valid CRC multiframe alignment condition after:

(a) achievement of the frame alignment state; and

(b) upon detection of two valid CRC multiframe alignment signals which are located within 8 ms, at exactly 2, 4, 6 or 8 ms apart.

5.2.13.3.2 The search for the CRC multiframe alignment signals **shall** be made only in time slot 0 in odd numbered frames, refer Table 1.

5.2.13.3.3 If multiframe alignment cannot be achieved within 8 ms, the CE **shall** initiate a new frame alignment search.

Note: The frame alignment search should be started at a point just after the location of the assumed simulated frame alignment signal so as to prevent realignment to the simulation.

5.2.13.4 **CRC Bit Monitoring**

When correct alignment of the frame and multiframe have been achieved by the CE, monitoring of the CRC check in each sub multiframe (SMF) **shall** commence.

5.2.14 **Alarm Bits**

5.2.14.1 **CE to Network Alarm Bit**

5.2.14.1.1 The bit stream from the network to the CE **shall** be monitored by the CE. The CE **shall** set bit 3 of odd numbered frames (bit A in Table 1) to 1 in the bit stream transmitted to the network if any of the following events is detected:

(a) AIS received; or

(b) Loss of received signal; or

(c) Loss of frame alignment with received signal; or

(d) High bit error ratio in the received signal which is worse than 1 in 10^3 for a period of n seconds where the recommended value for n is 10, refer ITU–T Rec. G.821 [27], Annex A.

Note: The preferred method of this error detection is CRC–4 error checking. However, this should not be used to rule out other methods which are also valid, such as errors found in frame synchronisation sequence. In addition, a bit error ratio of 1.0 in 10^3 corresponds to 831 CRC Errors/1000 Transmission Units if CRC–4 is used.

5.2.14.1.2 If none of the above events is detected by the CE, bit A **shall** be set to 0.

Compliance with Clause 5.2.14.1.2 ***shall*** *be checked by using the methods described in Clauses 6.2.1, 6.2.2, 6.2.3, and 6.2.4.*

5.2.14.2 **Network to CE Alarm Bit**

5.2.14.2.1 The bit stream from the CE to the network **shall** be monitored by the network. The network **shall** set bit 3 of odd numbered frames (bit A in Table 1) to 1 in the bit stream transmitted to the CE if any of the following events are detected:

(a) Loss of received signal; or

(b) Loss of frame alignment with received signal; or

(c) High bit error ratio in the received signal which is worse than 1 in 10^3 for a period of n seconds where n is a value set by the network Manager to between 5 and 60 (nominal value of 10).

Note: This bit may also be set due to detection of a fault condition in the NT1 to ET direction.

5.2.14.2.2 Bit A **shall** also be capable of being set to 1 during loop back testing of the transmission link within the network.

Note: Loop back testing facilities are currently not specified, nor a method of activation defined.

5.2.14.2.3 If none of the above events is detected by the network and a loop back test is not in progress, bit A **shall** be set to 0.

5.2.15 **National Information Bits**

Bits BCDEF (bits 4 to 8 of odd numbered frames as defined in Table 1) are National Information Bits. These bits are not used across the CE interface and **shall** all be set to 1 by the CE.

5.2.16 Idle Codes

5.2.16.1 Idle Time Slots

5.2.16.1.1 For both directions of transmission, the idle code **shall** consist of a pattern which includes at least three binary 1s in an octet.

5.2.16.1.2 The idle code **shall** be transmitted on:

(a) every time slot that is not assigned to a channel (e.g. a time slot awaiting channel assignment on a per–call basis or a residual time slot on an interface that is not fully provisioned, etc.); and

(b) every time slot of a channel that is not allocated to a call.

Note: The idle code is not required to be transmitted on a channel which is being tested.

5.2.16.1.3 The receiving side **shall not** deduce the idle status of a time slot or channel from the presence of the idle pattern. This status **shall** be deduced from signalling messages, customer subscription profile, etc.

5.2.16.2 D–Channel Interframe Timefill

A bit pattern of contiguous octets corresponding to the HDLC flag sequence (01111110) **shall** be transmitted on the D–Channel by layer 2 when there are no other frames to be sent.

5.3 Data Link Layer – Layer 2

5.3.1 General

5.3.1.1 Link Access Procedure

5.3.1.1.1 This section describes in general terms the Link Access Procedure on the D–Channel (LAPD) which is used to convey information between layer 3 entities across the ISDN CE interface using the D–Channel.

5.3.1.1.2 LAPD is a protocol that operates at the data link layer of the OSI architecture. The relationship between the data link layer and other protocol layers is defined in ITU–T Rec. I.320 [31] while the characteristics of the D–Channel are defined in ITU–T Rec.I.412 [34].

Note 1: The physical layer is defined in Clause 5.2 and layer 3 is defined in Clause 5.4 of this Technical Standard. References should be made to these Clauses for the complete definition of the protocols and procedures across the CE interface.

Note 2: The term 'data link layer' is used in the main text of this Standard. However, mainly in figures and tables, the terms 'layer 2' and 'L2' are used as abbreviations. Furthermore, in accordance with Clause 5.4 the term 'layer 3' is used to indicate the layer above the data link layer.

5.3.1.1.3 LAPD is independent of the transmission bit rate and requires a duplex, bit transparent D–Channel.

5.3.1.2 **Concepts and Terminology**

5.3.1.2.1 The basic structuring technique in the OSI reference model is layering. Accordingly, communication among application processes is viewed as being logically partitioned into an ordered set of layers represented in a vertical sequence as shown in Figure 1.

5.3.1.2.2 Entities exist in each layer. Entities in the same layer, but in different systems, which must exchange information to achieve a common objective are called 'peer entities'. Entities in adjacent layers interact through their common boundary. The services provided by the data link are the combination of the services and functions provided by both the data link layer and the physical layer.

5.3.1.2.3 A data link layer Service Access Point (SAP) is the point at which the data link layer provides services to layer 3. Associated with each data link layer SAP is one or more data link connection endpoint(s) refer Figure 2. A data link connection endpoint is identified by a data link Connection Endpoint Identifier (CEI) as seen from layer 3 and by a Data Link Connection Identifier (DLCI) as seen from the data link layer.

5.3.1.2.4 Co–operation between data link layer entities is governed by a peer–to–peer protocol specific to the layer. In order for information to be exchanged between two or more layer 3 entities, an association must be established between the layer 3 entities in the data link layer using a data link layer protocol. This association is called a data link connection. Data link connections are provided by the data link layer between two or more SAPs, refer Figure 3.

5.3.1.2.5 Data link layer message units are conveyed between data link layer entities by means of a physical connection.

5.3.1.2.6 Layer 3 requests services from the data link layer via service primitives. The same applies for the interaction between the data link layer and the physical layer. The primitives represent, in an abstract way, the logical exchange of information and control between the data link layer and adjacent layers. They do not specify or constrain implementation.

5.3.1.2.7 The primitives that are exchanged between the data link layer and adjacent layers are of the following four types (also refer Figure 4):

(a) request;

(b) indication;

(c) response; and

(d) confirm.

5.3.1.2.8 The REQUEST primitive type is used when a higher layer is requesting a service from the next lower layer.

5.3.1.2.9 The INDICATION primitive type is used by a layer providing a service to notify the next higher layer of any specific activity which is service related. The INDICATION primitive may be the result of an activity of the lower layer related to the primitive type REQUEST at the peer entity.

5.3.1.2.10 The RESPONSE primitive type is used by a layer to acknowledge receipt, from a lower layer, of the primitive type INDICATION.

5.3.1.2.11 The CONFIRM primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

5.3.1.2.12 Information is transferred, in various types of message units, between peer entities and between entities in adjacent layers that are attached to a specific SAP. The message units are of two types:

(a) message units of a peer–to–peer protocol; and

(b) message units that contain layer–to–layer information concerning status and specialized service requests.

5.3.1.2.13 The message units of the layer 3 peer–to–peer protocol are carried by the data link connection. The message units containing layer to layer information concerning status and specialized service requests are never conveyed over a data link connection or a physical connection.

5.3.1.2.14 This Technical Standard specifies (see also Figure 5):

(a) The peer–to–peer protocol for the transfer of information and control between any pair of data link layer service access points; and

(b) The interactions between the data link layer and layer 3, and between the data link layer and the physical layer.

5.3.1.3 Overview of LAPD Functions and Procedures

5.3.1.3.1 Messages

5.3.1.3.1.1 All data link layer messages are transmitted in frames which are delimited by flags. (A flag is a unique bit pattern.) The frame structure is defined in Clause 5.3.2.

5.3.1.3.1.2 LAPD includes function for:

(a) the provision of one or more data link connections on a D–Channel. Discrimination between the data link connections is by means of a data link connection identifier (DLCI) contained in each frame;

(b) frame delimiting, alignment and transparency, allowing recognition of a sequence of bits transmitted over a D–Channel as a frame;

(c) sequence control, to maintain the sequential order of frames across a data link connection;

(d) detection of transmission, format and operational errors on a data link connection;

(e) recovery from detected transmission, format, and operational errors;

(f) Notification to the management entity of unrecoverable errors; and

(g) flow control.

5.3.1.3.1.3 Generally, data link layer functions provide the means for information transfer between multiple combinations of data link connection endpoints. The information transfer may be via point–to–point data link connections or via broadcast data link connections. In the case of point–to–point information transfer, a frame is directed to a single endpoint, while in the case of broadcast information transfer, a frame is directed to one or more endpoints.

5.3.1.3.1.4 In this Standard information transfer is via a single point–to–point data link connection.

5.3.1.3.1.5 Figure 6 shows an example of point–to–point information transfer.

5.3.1.3.2 **Acknowledged Operation**

5.3.1.3.2.1 With acknowledged operation, layer 3 information is transmitted in frames that are acknowledged at the data link layer.

5.3.1.3.2.2 Error recovery procedures based on retransmission of unacknowledged frames are specified. In the case of errors which cannot be corrected by the data link layer, a report to the management entity is made. Flow control procedures are also defined.

5.3.1.3.2.3 Acknowledged operation is applicable for point–to–point information transfer. One form of acknowledged information transfer is defined: multiple frame operation.

5.3.1.3.2.4 Layer 3 information is sent in numbered information (I) frames. A number of I frames may be outstanding at the same time. Multiple frame operation is initiated by a multiple frame establishment procedure using a Set Asynchronous Balanced Mode Extended (SABME) command.

5.3.1.3.3 **Data Link Connection Identification**

5.3.1.3.3.1 A data link connection is identified by a Data Link Connection Identifier (DLCI) carried in the address field of each frame.

5.3.1.3.3.2 The data link connection identifier is associated with a connection endpoint identifier at the two ends of the data link connection as shown in Figure 7.

5.3.1.3.3.3 The Connection Endpoint Identifier (CEI) is used to identify message units passed between the data link layer and layer 3. It consists of the Service Access Point Identifier (SAPI) and the connection endpoint suffix.

5.3.1.3.3.4 The Data Link Connection Identifier (DLCI) consists of two elements: the Service Access Point Identifier (SAPI) and the Terminal Endpoint Identifier (TEI).

5.3.1.3.3.5 The SAPI is used to identify the service access point on the network side or the CE side of the CE interface.

5.3.1.3.3.6 The TEI is used to identify a specific connection endpoint within a service access point.

5.3.1.3.3.7 The TEI is assigned at the time of subscription and may be entered into the CE, for example, by the user or the manufacturer.

5.3.1.3.3.8 The DLCI is a pure data link layer concept. It will be internally used by the data link layer entity and is not known by the layer 3 entity or management entity. In these latter entities, the concept of Connection Endpoint Identifier (CEI) will be used instead.

5.3.1.3.3.9 The CEI is composed of the SAPI information and a reference value named Connection Endpoint Suffix (CES). The CES is a value selected by the layer 3 or management entity to address the Data link layer entity. When the relevant TEI is known by this entity, it will internally associate the DLCI to the CEI. The layer 3 and management entities **shall** use this CEI to address its peer entity.

5.3.1.3.4 **Data Link States**

5.3.1.3.4.1 A point–to–point link entity may be in one of two basic states:

(a) TEI–assigned state. In this state a TEI has been assigned; or

(b) multiple–frame–established state. This state is established by means of a multiple frame establishment procedure. Acknowledged multiple frame information transfer is possible.

5.3.1.3.4.2 Key:

(a) Point–to–point data link

(b) DLCI (Data link connection identifier) = SAPI + TEI

(c) Connection endpoint identifier = SAPI + Connection Endpoint Suffix

Note: The management entity is not shown in Figure 7.

5.3.1.3.5 **Establishment of Multiple Frame Operation**

5.3.1.3.5.1 Before point–to–point acknowledged information transfer may start, an exchange of a SABME frame and an Unnumbered Acknowledgement (UA) frame must take place.

5.3.1.3.5.2 The multiple frame establishment procedure is specified in Clause 5.3.2 of this Technical standard.

5.3.1.4 **Service Characteristics**

5.3.1.4.1 **Services Provided to Layer 3**

5.3.1.4.1.1 The data link layer provides services to layer 3 and to the layer 2 management and utilizes the services provided by the physical layer and layer management.

Note: Communication between different layers in the OSI reference model makes use of primitives which are passed across the layer boundaries. The data link layer primitives defined herein represent, in an abstract way, the logical exchange of information and control between the data link layer and adjacent layers. They do not specify nor constrain implementations.

5.3.1.4.1.2 The specification of the interactions with layer 3 (primitives) provides a description of the services that the data link layer, plus the physical layer, offer to layer 3, as viewed from layer 3.

5.3.1.4.1.3 Only one form of information transfer service is associated with layer 3. This service is based on acknowledged information transfer at the data link layer.

5.3.1.4.1.4 The data link layer also provides administrative services for layer 3 in order to implement information transfer services.

5.3.1.4.1.5 Layer 3 message units are handled according to their respective layer 3 priority.

5.3.1.4.2 **Acknowledged Information Transfer Service**

5.3.1.4.2.1 Only one mode of operation is defined, that is, multiple frame.

5.3.1.4.2.2 The characteristics of the acknowledged information transfer service are summarized in the following:

(a) Provision of a data link connection between layer 3 entities for acknowledged information transfer of layer 3 message units;

(b) identification of data link connection endpoints;

(c) sequence integrity of data link layer message units in the absence of malfunctions;

(d) notification to the peer entity in the case of errors; for example, loss of sequence;

(e) notification to the management entity of unrecoverable errors detected by the data link layer; and

(f) flow control.

5.3.1.4.2.3 The primitives associated with the acknowledged information transfer services are:

(a) Data transfer

DL–DATA–REQUEST/INDICATION

The DL–DATA–REQUEST primitive is used to request that a message unit be sent using the procedures for acknowledged information transfer service. The DL–DATA–INDICATION primitive indicates the arrival of a message unit received by means of acknowledged information transfer service.

(b) Establishment of multiple frame operation

DL–ESTABLISH–REQUEST/INDICATION/CONFIRM

These primitives are used respectively to request, indicate and confirm the establishment of multiple frame operation between two service access points.

(c) Termination of multiple frame operation

DL–RELEASE–REQUEST/INDICATION/CONFIRM

These primitives are respectively used to request, indicate and confirm an attempt to terminate multiple frame operation between two service access points.

5.3.1.4.3 **Administrative Services**

5.3.1.4.3.1 The method of describing administrative functions is to use service primitives.

5.3.1.4.3.2 The primitive associated with the notification of error service is, MDL–ERROR–INDICATION/RESPONSE. This primitive is used to report error conditions between layer management and the data link layer entities.

5.3.1.4.4 **Model of the Data Link Service**

5.3.1.4.4.1 **General**

5.3.1.4.4.1.1 The ability of the data link layer to execute a service request by layer 3 depends on the internal state of the data link layer. For each layer 3 entity, the internal state of the data link layer is represented by the state of that data link connection endpoint within a data link service access point which is used by this layer 3 entity to invoke a service.

5.3.1.4.4.1.2 Consequently, the data link service may be defined by a model of a data link connection and the definition of data link connection endpoint states, whereby the capabilities provided by the data link layer and the service primitives may be related to these states.

5.3.1.4.4.1.3 In order to allow a data link service user to invoke a service making use of primitives, the DL–primitives defined in Clause 5.3.2 have to be related to point–to–point data link connections and acknowledged transfer of information (see Table 2.)

Table 2
Applicability of DL–Primitives to Information Transfer Modes

Generic Name of the DL–PRIMITIVE	Acknowledged Point–to–Point Information Transfer Mode
Establish	Confirmed Service
Release	Confirmed Service
Data	Unconfirmed Service

5.3.1.4.4.1.4 An Unconfirmed Service is defined as a service which does not result in an explicit confirmation. A Confirmed Service is defined as a service which results in an explicit confirmation from the service provider. There is not necessarily any relationship to a response from the peer service user.

5.3.1.4.5 **Data Link Layer Representation as Seen by Layer 3**

5.3.1.4.5.1 **Data Link Connection Endpoint States**

The states of a data link connection endpoint may be derived from the internal states of the data link layer entity supporting this type of a data link connection.

5.3.1.4.5.2 **Point–to–Point Data Link Connection Endpoint Services**

5.3.1.4.5.2.1 A data link connection provides an acknowledged information transfer service. Within each data link service access point, one or more than one data link connection endpoint may be present; each identified by a CEI.

5.3.1.4.5.2.2 The acknowledged information transfer service, in addition, implies the presence of the services link establishment, link re–establishment and link release.

5.3.1.4.5.2.3 The point–to–point data link connection endpoint states are:

(a) LINK CONNECTION RELEASED state;

(b) AWAITING ESTABLISH state;

(c) AWAITING RELEASE state;

(d) LINK CONNECTION ESTABLISHED state.

5.3.1.4.5.3 **Sequences of Primitives at One Point–to–Point Data Link Connection Endpoint**

5.3.1.4.5.3.1 The primitives provide the procedural means to specify conceptually how a data link service user can invoke a service.

5.3.1.4.5.3.2 This section defines the constraints on the sequence in which the primitives may occur. The sequences are related to the states at one point–to–point data link connection endpoint.

5.3.1.4.5.3.3 The possible overall sequences of primitives at a point–to–point data link connection endpoint are defined in the state transition diagram, Figure 8. The LINK CONNECTION RELEASED and LINK CONNECTION ESTABLISHED states are stable states whilst the AWAITING ESTABLISH and AWAITING RELEASE are transition states.

5.3.1.4.6 **Services Required From the Physical Layer**

5.3.1.4.6.1 The services provided by the physical layer are described in detail in Clause 5.3.2. They are summarized in the following:

(a) physical layer connection for the transparent transmission of bits in the same order in which they are submitted to the physical layer;

(b) indication of the physical status of the D–Channel; and

(c) transmission of data link layer message units according to their respective data link layer priority.

5.3.1.4.6.2 Some of the above services may be implemented in the management entity on the CE side or network side. The method of describing these services is by means of service primitives. The primitive between the data link layer and the physical layer for Data transfer is, PH–DATA–REQUEST/INDICATION. This primitive is used to request that a message unit be sent and to indicate the arrival of a message unit.

5.3.1.5 **Data Link – Management Layer Structure**

5.3.1.5.1 **General**

5.3.1.5.1.1 The data link – management layer structure is shown in Figure 9. This figure is a model shown for illustrative purposes only, and does not constrain implementations.

5.3.1.5.1.2 The layer management entity (LME) provides for the management of resources that have a layer wide impact. Access to the LME is provided by means of a specific SAPI. There is no function provided by the LME in this Standard.

5.3.1.5.1.3 The connection management entity (CME) provides for the management of resources that have an impact on individual connections. Selection of the CME is based on a specific data link layer frame type not used in the acknowledged information transfer services. Functions provided by the CME are:

(a) error processing;

(b) connection flow control invocation.

5.3.1.5.2 **Data Link Procedure**

This procedure analyses the control field of the received frame (see Clause 5.3.2) and provides appropriate peer–to–peer responses and layer–to–layer indications. In addition, it analyses the data link layer service primitives and transmits the appropriate peer–to–peer commands and responses.

5.3.1.5.3 **Multiplex Procedure**

5.3.1.5.3.1 This procedure analyses the flag, Frame Check Sequence (FCS), and address octets of a received frame. If the frame is correct, it distributes the frame to the appropriate data link procedure block based on the DLCI (see Clause 5.3.2).

5.3.1.5.3.2 On frame transmission, this procedure may provide data link layer contention resolution between the various data link procedure blocks. The contention resolution is based on the SAPI, giving priority to signalling information.

5.3.1.5.4 **Structure of the Data Link Procedure**

The functional model of the data link procedure is shown in Figure 10. The model consists of a single block for point–to–point connection.

5.3.1.6 **Testing**

The layer 2 conformance tests that **shall** be performed on CE to verify compliance with Clause 5.3 are contained in Clause 6.3.

5.3.2 **Data Link Layer Specification**

5.3.2.1 **General**

This Clause specifies the frame structure, elements of procedure, format of fields, and procedures for the proper operation of the Link Access Procedure on the D–Channel, LAPD.

5.3.2.2 **Frame Structure for Peer–to–Peer Communication**

5.3.2.2.1 **Formats**

All data link layer peer–to–peer communications **shall** be in frames conforming to one of the formats shown in Table 3. Two format types are shown in Table 3. Format A **shall** be used for frames where there is no information field and Format B **shall** be used for frames containing an information field.

5.3.2.2.2 **Flag Sequence**

All frames **shall** start and end with the flag sequence consisting of one '0' bit followed by six contiguous '1' bits and one '0' bit. The flag preceding the address field is called the opening flag. The flag following the Frame Check Sequence (FCS) field is called the closing flag. The closing flag of a frame may also serve as

the opening flag of the next frame however, a receiver **shall** be able to accommodate the receipt of one or more consecutive flags.

5.3.2.2.3 **Address Field**

The address field **shall** consist of two octets as illustrated in Table 3. The address field identifies the intended receiver of a command frame and the transmitter of a response frame. The format of the address field is defined in Clause 5.3.2.3.2.

5.3.2.2.4 **Control Field**

5.3.2.2.4.1 The control field **shall** consist of one or two octets. Table 3 illustrates the two frame formats (A and B), each with a control field of one or two octets, depending upon the type of operation being used.

5.3.2.2.4.2 The format of the control field is defined in Clause 5.3.2.3.4.

5.3.2.2.5 **Information Field**

5.3.2.2.5.1 The information field of a frame, when present, follows the control field (see Clause 5.3.2.2.4) and precedes the frame check sequence (see Clause 5.3.2.2.7). The contents of the information field **shall** consist of an integral number of octets.

5.3.2.2.5.2 The maximum number of octets in the information field is defined in Clause 5.3.2.5.7.3.

5.3.2.2.6 **Transparency**

A transmitting data link layer entity **shall** examine the frame content between the opening and closing flag sequences, (address, control, information and FCS fields) and **shall** insert a '0' bit after all sequences of five contiguous '1' bits (including the last five bits of the FCS) to ensure that a flag or an abort sequence is not simulated within the frame. A receiving data link layer entity **shall** examine the frame contents between the opening and closing flag sequences and **shall** discard any '0' bit which directly follows five contiguous '1' bits.

Table 3
Frame Formats

Format A

8	7	6	5	4	3	2	1	Octet
Flag 0	1	1	1	1	1	1	0	1
Address (high order octet)								2

Format B

8	7	6	5	4	3	2	1	Octet
Flag 0	1	1	1	1	1	1	0	1
Address (high order octet)								2

Address (low order octet)	3		Address (low order octet)	3
Control (Note) Control (Note)	4		Control (Note) Control (Note)	4
FCS (first octet)	N–2		Information	○ ○ ○
FCS (second octet)	N–1		FCS (first octet)	N–2
Flag 0 1 1 1 1 1 1 0	N		FCS (second octet)	N–1
			Flag 0 1 1 1 1 1 1 0	N

Note: Unacknowledged operation – one octet

Multiple frame operation – Control field is 1 octet for frames without sequence numbers and 2 octets for frames with sequence numbers.

5.3.2.2.7 **Frame Checking Sequence (FCS) Field**

5.3.2.2.7.1 The FCS field **shall** be a sixteen–bit sequence. It **shall** be the ones complement of the sum (modulo 2) of:

(a) The remainder of (x raised to k power)

$$(x^{15} + x^{14} + x^{13} + x^{12} + x^{11} + x^{10} + x^{9} + x^{8} + x^{7} + x^{6} + x^{5} + x^{4} + x^{3} + x^{2} + x^{1} + 1)$$

divided (modulo 2) by the generator polynomial $x^{16}+x^{12}+x^{5}+1$, where k is the number of bits in the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency; and

(b) the remainder of the division (modulo 2) by the generator polynomial $x^{16}+x^{12}+x^{5}+1$, of the product of x^{16} by the content of the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency.

5.3.2.2.7.2 As a typical implementation at the transmitter, the initial content of the register of the device computing the remainder of the division is preset to all '1's and is then modified, by division, by the generator polynomial (as described above) on the address, control, and information fields; the '1's complement of the resulting remainder is transmitted as the sixteen–bit FCS sequence.

5.3.2.2.7.3 As a typical implementation at the receiver, the initial content of the register of the device computing the remainder is preset to all '1's. The final remainder after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16}+x^{12}+x^{5}+1$, of the serial incoming protected bits and the FCS, will be

'0001 1101 0000 1111' (x^{15} through x^{0}, respectively) in the absence of transmission errors.

5.3.2.2.8 **Format Convention**

5.3.2.2.8.1 **Numbering Convention**

The basic convention used in this standard is illustrated in Table 4. The bits are grouped into octets. The bits of an octet are shown horizontally and are numbered from 1 to 8. Multiple octets are shown vertically and are numbered from 1 to n.

Table 4
Format Convention

8	7	6	5	4	3	2	1	
								Octet 1
								2
								• • • •
								n

5.3.2.2.8.2 **Order of Bit Transmission**

The octets are transmitted in ascending numerical order; inside an octet bit 1 is the first bit to be transmitted.

5.3.2.2.8.3 **Field Mapping Convention**

5.3.2.2.8.3.1 When a field is contained within a single octet, the lowest bit number of the field represents the lowest order value.

5.3.2.2.8.3.2 When a field spans more than one octet, the order of bit values within each octet progressively decreases as the octet number increases. The lowest bit number associated with the field represents the lowest order value.

5.3.2.2.8.3.3 For example, a bit number can be identified as a couple (o,b) where o is the octet number and b is the relative bit number within the octet. Table 5 illustrates a field that spans from bit (1,3) to bit (2,7). The high order bit of the field is mapped on bit (1,3) and the low order bit is mapped on bit (2,7).

Table 5
Field Mapping Convention

8	7	6	5	4	3	2	1	
					2^4	2^3	2^2	1st octet of the field
2^1	2^0							2nd octet of the field

5.3.2.2.8.3.4 An exception to the preceding field mapping convention is the data link layer Frame Check Sequence (FCS) field, which spans two octets. In this case, bit 1 of the first octet is the high order bit and bit 8 of the second octet is the low order bit (see Table 6).

Table 6
Frame Check Sequence (FCS) Field Mapping Convention

8	7	6	5	4	3	2	1	
2^8							2^{15}	1st octet of the field
2^0							2^7	2nd octet of the field

5.3.2.2.9 **Invalid Frames**

5.3.2.2.9.1 An invalid frame is a frame which:

(a) is not properly bounded by two flags; or

(b) for modulo 128 multiple frame acknowledged operation has fewer than 6 octets between flags of frames that contain sequence numbers and fewer than 5 octets between flags of frames that do not contain sequence numbers; or

(c) does not consist of an integral number of octets prior to zero bit insertion or following zero bit extraction; or

(d) contains a frame check sequence error; or

(e) contains a single octet address field.

5.3.2.2.9.2 Invalid frames **shall** be discarded without notification to the sender. No action is taken as the result of that frame.

5.3.2.2.10 **Frame Abort**

Receipt of seven or more contiguous '1' bits **shall** be interpreted as an abort and the data link layer **shall** ignore the frame currently being received.

5.3.2.2.11 **Interframe Timefill**

A bit pattern of contiguous octets corresponding to the HDLC flag sequence (01111110) **shall** be transmitted on the D channel when layer 2 has no frames to send.

5.3.2.3 **Elements of Procedures and Formats of Fields for Data Link Layer Peer–to–Peer Communications**

5.3.2.3.1 **General**

5.3.2.3.1.1 The elements of procedures define the commands and responses that are used on the data link connections carried on the D–Channel.

5.3.2.3.1.2 Procedures are derived from these elements of procedures and are described in Clause 5.3.2.5.

5.3.2.3.2 **Address Field Format**

The address field format shown in Table 7 contains the address field extension bits, a command/response indication bit, a data link layer service access point identifier (SAPI) subfield, and a terminal endpoint identifier (TEI) subfield.

Table 7
Address Field Format

Bits 8	7	6	5	4	3	2	1	Octet
SAPI						C/R	EA 0	2
TEI							EA 1	3

EA = Address field extension bit

C/R = Command/response field bit

SAPI = Service access point identifier

TEI = Terminal endpoint identifier

5.3.2.3.3 **Address Field Variables**

5.3.2.3.3.1 **Address Field Extension Bit (EA)**

The address field range is extended by reserving the first transmitted bit of the address field octets to indicate the final octet of the address field. The presence of a '1' in the first bit of an address field octet signals that it is the final octet of the address field. The double octet address field for LAPD operation **shall** have bit 1 of the first octet set to a '0' and bit 1 of the second octet set to '1'.

5.3.2.3.3.2 **Command/Response (C/R) Field Bit**

5.3.2.3.3.2.1 The C/R bit identifies a frame as either a command or a response. The CE side **shall** send commands with the C/R bit set to '0', and responses with the C/R bit set to '1'. The network side **shall** do the opposite; that is commands are sent with C/R set to '1', and responses are sent with C/R set to '0'. The combinations for the network side and CE side are shown in Table 8.

Table 8
C/R Field Bit Usage

Command/Response	Direction	C/R Value
Command	Network side → CE side	1
	CE side → network side	0
Response	Network side → CE side	0
	CE side → network side	1

5.3.2.3.3.2.2 In conformance with HDLC rules, commands use the peer data link layer entity's address while responses use the own data link layer entity's address. According to these rules, both peer entities on a point–to–point data link connection use the same Data Link Connection Identifier (DLCI) composed of a SAPI–TEI where SAPI and

TEI conform to the definitions contained in Clauses 5.3.2.3.3.3 and 5.3.2.3.3.4 and define the data link connection as described in Clause 5.3.1.3.3.

5.3.2.3.3.3 **Service Access Point Identifier (SAPI)**

5.3.2.3.3.3.1 The SAPI identifies a point at which data link layer services are provided by a data link layer entity to a layer 3 or management entity. Consequently, the SAPI specifies a data link layer entity that should process a data link layer frame. The SAPI allows 64 service access points to be specified, where bit 3 of the address field octet containing the SAPI is the least significant binary digit and bit 8 is the most significant. The SAPI values are allocated as shown in Table 9.

Table 9
Service Access Point Identifier (SAPI)

SAPI Value	Related Layer 3 or Management Entity
0	Call Control Procedures
All others	Reserved for future standardisation

5.3.2.3.3.4 **Terminal Endpoint Identifier (TEI)**

The terminal endpoint identifier (TEI) for a point–to–point data link connection may be associated with a single terminal (TE). A TE may be associated with only one TEI. The TEI for a broadcast data link connection is associated with all CE side data link layer entities containing the same SAPI, however, it is not used in this Standard. The TEI subfield allows 128 values where bit 2 of the address field octet containing the TEI is the least significant binary digit and bit 8 is the most significant binary digit. The following conventions **shall** apply in the assignment of these values.

5.3.2.3.3.4.1 **TEI for Point–to–Point Data Link Connection**

For this Technical Standard, the network side and the CE side are assigned the TEI value of ‘0’.

5.3.2.3.4 **Control Field Formats**

5.4.2.3.4.1 The control field identifies the type of frame, which will be either a command or response. The control field will contain sequence numbers, where applicable.

5.4.2.3.4.2 Three types of control field formats are specified; numbered information transfer (I format), supervisory functions (S format), and unnumbered information transfers and control functions (U format). The control field formats for extended (Modulo 128) operation are shown in Table 10.

Table 10
Control Field Formats

Control Field Bits	8	7	6	5	4	3	2	1	
I format	N(S)							0	Octet 4
	N(R)							P	5
S format	X	X	X	X	S	S	0	1	Octet 4
	N(R)							P/F	5
U format	M	M	M	P/F	M	M	1	1	Octet 4

N(S): Transmitter send sequence number

M: Modifier function bit

N(R): Transmitter receive sequence number

P/F: Poll bit when issued as a command, final bit when issued as a response

S: Supervisory function bit

X: Reserved and set to 0

5.3.2.3.4.1 **Information Transfer Format**

5.3.2.3.4.1.1 The I format **shall** be used to perform an information transfer between layer 3 entities. The functions of N(S), N(R) and P (defined in Clause 5.3.2.3.5) are independent; that is, each I frame has an N(S) sequence number, an N(R) sequence number which may or may not acknowledge additional I frames received by the data link layer entity, and a P bit that may be set to '0' or '1'.

5.3.2.3.4.1.2 The use of N(S), N(R), and P is defined in Clause 5.3.2.5.

5.3.2.3.4.2 **Supervisory Format – S**

The S format **shall** be used to perform data link supervisory control functions such as:

(a) acknowledge I frames;

(b) request retransmission of I frames; and

(c) request a temporary suspension of transmission of I frames.

The functions of N(R) and P/F are independent, that is, each supervisory frame has an N(R) sequence number which may or may not acknowledge additional I frames received by the data link layer entity, and a P/F bit that may be set to '0' or '1'.

5.3.2.3.4.3 **Unnumbered Format – U**

The U format **shall** be used to provide additional data link control functions. This format does not contain sequence numbers. It does include a P/F bit that may be set '0' or '1'. The unnumbered frames have a control field of one octet long.

5.3.2.3.5 Control Field Parameters and Associated State Variables

The various parameters associated with the control field formats are described below. The coding of the bits within parameters is such that the lowest numbered bit within the parameter field is the least significant bit.

5.3.2.3.5.1 Poll/Final (P/F) Bit

5.3.2.3.5.1.1 All frames **shall** contain a P/F bit. TheP/F bit serves a function in both command frames and response frames. In command frames the P/F bit is referred to as the P bit. In response frames it is referred to as the F bit. The P bit set to '1' is used by a data link layer entity to solicit (poll) a response frame from the peer data link layer entity. The F bit set to '1' is used by a data link layer entity to indicate the response frame transmitted as a result of a soliciting (poll) command.

5.3.2.3.5.1.2 The use of the P/F bit is described in Clause 5.3.2.5.

5.3.2.3.5.2 Multiple Frame Operation – Variables and Sequence Numbers

5.3.2.3.5.2.1 Modulus

Each I frame is sequentially numbered and may have the value 0 through 127. The modulus equals 128.

Note: All arithmetic operations on state variables and sequence numbers contained in this standard are affected by the modulus operation.

5.3.2.3.5.2.2 Send State Variable V(S)

Each point–to–point data link connection endpoint **shall** have an associated send state variable V(S) when using I frame commands. The send state variable denotes the sequence number of the next I frame to be transmitted. The send state variable can take on the value 0 through 127. The value of the send state variable **shall** be incremented by 1 with each successive I frame transmission, and **shall not** exceed V(A) (see Clause 5.3.2.3.5.2.3.) by more than the maximum number of outstanding I frames, k. The value of k may be in the range of 1 • k • 127.

5.3.2.3.5.2.3 Acknowledge State Variable V(A)

Each point–to–point data link connection endpoint **shall** have an associated acknowledge state variable V(A) when using I frame commands and supervisory frame commands/responses. The acknowledge state variable identifies the last frame that has been acknowledged by its peer (V(A)–1 equals the N(S) of the last acknowledged I frame). The acknowledge state variable can take on the value 0 through 127. The value of the acknowledge state variable **shall** be updated by the valid N(R) values received from its peer (see Clause 5.3.2.3.5.2.6). A valid N(R) value is one that is in the range:

V(A) ˙ N(R) • V(S)

5.3.2.3.5.2.4 Send Sequence Number N(S)

Only I frames contain N(S), the send sequence number of transmitted I frames. At the time that an in–sequence I frame is designated for transmission, the value of N(S) is set equal to the value of the send state variable V(S).

5.3.2.3.5.2.5 **Receive State Variable V(R)**

Each point–to–point data link connection endpoint **shall** have an associated receive state variable V(R) when using I frame commands and supervisory frame commands/responses. The receive state variable denotes the sequence number of the next in–sequence I frame expected to be received. The receive state variable can take on the value 0 through 127. The value of the receive state variable **shall** be incremented by one with the receipt of an error–free, in–sequence I frame whose send sequence number N(S) equals the receive state variable V(R).

5.3.2.3.5.2.6 **Receive Sequence Number N(R)**

All I frames and supervisory frames contain N(R), the expected send sequence number of the next received I frame. At the time that a frame of the above types is designated for transmission, the value of N(R) is set equal to the current value of the receive state variable V(R). N(R) indicates that the data link layer entity transmitting the N(R) has correctly received all I frames numbered up to and including N(R) – 1.

5.3.2.3.6 **Frame Types**

5.3.2.3.6.1 **Commands and Responses**

5.3.2.3.6.1.1 The following commands and responses are used by either the CE or the network data link layer entities and are represented in Table 10. Each data link connection **shall** support the full set of commands and responses identified in Table 11 for Modulo 128 multiple frame acknowledged operation.

5.3.2.3.6.1.2 For purposes of the LAPD procedures, the supervisory function bit encoding '11' and those encodings of the modifier function bits in Table 4 not identified in Table 11 are identified as undefined command and response control fields (see Clause 5.3.2.5.6.2).

5.3.2.3.6.1.3 The commands and responses in Table 11 are defined in Clauses 5.3.2.3.6.2 to 5.3.2.3.6.10.

5.3.2.3.6.2 **Information (I) Command**

The function of the information (I) command is to transfer, across a data link connection, sequentially numbered frames containing information fields provided by layer 3. This command is used in the multiple frame operation on point–to–point data link connections.

Table 11
Commands and Responses – Unacknowledged and Multiple Frame Acknowledged (Modulo 128) Operation

Format	Commands	Responses	Encoding								Octet
			8	7	6	5	4	3	2	1	
Information Transfer	I (Information)		N(S)							0	4
			N(R)							P	5
Supervisory	RR (receive ready)	RR (receive ready)	0	0	0	0	0	0	0	1	4
			N(R)							P/F	5
	RNR (receive not ready)	RNR (receive not ready)	0	0	0	0	0	1	0	1	4
			N(R)							P/F	5
	REJ (reject)	REJ (reject)	0	0	0	0	1	0	0	1	4
			N(R)							P/F	5
Unnumbered	RR (receive ready)	RR (receive ready)	0	0	0	0	0	0	0	1	4
			N(R)							P/F	5
	RNR (receive not ready)	RNR (receive not ready)	0	0	0	0	0	1	0	1	4
			N(R)							P/F	5
	REJ (reject)	REJ (reject)	0	0	0	0	1	0	0	1	4
			N(R)							P/F	5
Unnumbered	SABME (set asynchronous Balance mode extended)		0	1	1	P	1	1	1	1	4
		DM (disconnect mode)	0	0	0	F	1	1	1	1	4
	DISC (disconnect)		0	1	0	P	0	0	1	1	4
		UA (unnumbered Acknowledged)	0	1	1	F	0	0	1	1	4
		FRMR (frame reject)	1	0	0	F	0	1	1	1	4

5.3.2.3.6.3 **Set Asynchronous Balanced Mode Extended (SABME) Command**

5.3.2.3.6.3.1 The SABME unnumbered command is used to place the addressed CE side or network side into modulo 128 multiple frame acknowledged operation.

5.3.2.3.6.3.2 No information field is permitted with the SABME command. A data link layer entity confirms acceptance of a SABME command by the transmission at the first opportunity of a UA response. Upon acceptance of this command, the data link layer entity's send state variable V(S), acknowledge state variable V(A), and receive state variable V(R) are set to '0'. The transmission of an SABME command indicates the clearance of all exception conditions.

5.3.2.3.6.3.3 Previously transmitted I frames that are unacknowledged when this command is processed remain unacknowledged and are discarded. It is the responsibility of a higher level (for example, layer 3) or the management entity to recover from the possible loss of the contents of such I frames.

5.3.2.3.6.4 **Disconnect (DISC) Command**

5.3.2.3.6.4.1 The DISC unnumbered command is used to terminate the multiple frame operation.

5.3.2.3.6.4.2 No information field is permitted with the DISC command. The data link layer entity receiving the DISC command confirms the acceptance of a DISC command by the transmission of a UA response. The data link layer entity sending the DISC command terminates the multiple frame operation when it receives the acknowledging UA or DM response.

5.3.2.3.6.4.3 Previously transmitted I frames that are unacknowledged when this command is processed remain unacknowledged and are discarded. It is the responsibility of a higher level (for example, layer 3) or the management entity to recover from the possible loss of the contents of such I frames.

5.3.2.3.6.5 **Receive Ready (RR) Command/Response**

5.3.2.3.6.5.1 The receive ready (RR) supervisory frame is used by a data link layer entity to:

(a) indicate it is ready to receive an I frame;

(b) acknowledge previously received I frames numbered up to and including N(R) – 1 (as defined in Clause 5.3.2.5); and

(c) clear a busy condition that was indicated by the earlier transmission of an RNR frame by that same data link layer entity.

5.3.2.3.6.5.2 In addition to indicating the status of a data link layer entity, the RR command with the P bit set to '1' may be used by the data link layer entity to ask for the status of its peer data link layer entity.

5.3.2.3.6.6 **Reject (REJ) Command/Response**

5.3.2.3.6.6.1 The reject (REJ) supervisory frame is used by a data link layer entity to request retransmission of I frames starting with the frame numbered N(R). The value of N(R) in the REJ frame acknowledges I frames numbered up to and including N(R) – 2. New I frames pending initial transmission **shall** be transmitted following the retransmitted I frame(s).

5.3.2.3.6.6.2 Only one REJ exception condition for a given direction of information transfer is established at a time. The REJ exception condition is cleared (reset) upon the receipt of an I frame with an N(S) equal to the N(R) of the REJ frame.

5.3.2.3.6.6.3 The transmission of a REJ frame also indicates the clearance of any busy condition within the sending data link layer entity that was reported by the earlier transmission of an RNR frame by that same data link layer entity.

5.3.2.3.6.6.4 In addition to indicating the status of a data link layer entity, the REJ command with the P bit set to '1' may be used by the data link layer entity to ask for the status of its peer data link layer entity.

5.3.2.3.6.7 **Receive Not Ready (RNR) Command/Response**

5.3.2.3.6.7.1 The receive not ready (RNR) supervisory frame is used by a data link layer entity to indicate a busy condition; that is, a temporary inability to accept additional incoming I frames. The value of N(R) in the RNR frame acknowledges I frames numbered up to and including N(R) – 1.

5.3.2.3.6.7.2 In addition to indicating the status of a data link layer entity, the RNR command with the P bit set to '1' may be used by the data link layer entity to ask for the status of its peer data link layer entity.

5.3.2.3.6.8 **Unnumbered Acknowledgement (UA) Response**

The UA unnumbered response is used by a data link layer entity to acknowledge the receipt and acceptance of the mode–setting commands (SABME or DISC). Received mode–setting commands are not actioned until the UA response is transmitted. No information field is permitted with the UA response. The transmission of the UA response indicates the clearance of any busy condition that was reported by the earlier transmission of an RNR frame by that same data link layer entity.

5.3.2.3.6.9 **Disconnected Mode (DM) Response**

The DM unnumbered response is used by a data link layer entity to report to its peer that the data link layer is in a state such that multiple frame operation cannot be performed. No information field is permitted with the DM response.

5.3.2.3.6.10 **Frame Reject (FRMR) Response**

5.3.2.3.6.10.1 The FRMR unnumbered response may be received by a data link layer entity as a report of an error condition not recoverable by retransmission of the identical frame, that is, at least one of the following conditions, which results from the receipt of a valid frame:

(a) The receipt of a command or response control field that is undefined or not implemented (see Clause 5.3.2.3.6.1);

(b) the receipt of a frame with an information field which is not permitted or the receipt of a supervisory or unnumbered frame with the incorrect length;

(c) the receipt of an invalid N(R); or

(d) the receipt of an I frame with an information field which exceeds the maximum established length.

5.3.2.3.6.10.2 An undefined control field is any of the control field encodings that are not identified in Table 11.

5.3.2.3.6.10.3 A valid N(R) value is one that is in the range between V(A) and V(S). (See Clause 5.3.2.3.5.2.3).

5.3.2.3.6.10.4 An information field which immediately follows the control field and consists of five octets is returned with this response and provides the reason for the FRMR response. This information field format is given in Table 12.

Table 12

FRMR Information Field Format – Extended

(Modulo 128 Operation)

8	7	6	5	4	3	2	1	
Rejected frame								Octet 5
Control field								6
V(S)								7
V(R)								8
0	0	0	0	Z	Y	X	W	9

Note 1: Rejected frame control field is the control field of the received frame which caused the frame reject. When the rejected frame is an unnumbered frame, the control field of the rejected frame is positioned in octet 5, with octet 6 set to '0000 0000'.

Note 2: V(S) is the current send state variable value on the CE side or network side reporting the rejection condition.

Note 3: C/R is set to '1' if the frame rejected was a response and is set to '0' if the frame rejected was a command.

Note 4: V(R) is the current receive state variable value on the CE side or network side reporting the rejection condition.

Note 5: W set to '1' indicates that the control field received and returned in octets 5 and 6 was undefined or not implemented.

Note 6: X set to '1' indicates that the control field received and returned in octets 5 and 6 was considered invalid because the frame contained an information field which is not permitted with this frame or is a supervisory or unnumbered frame with incorrect length. Bit W must be set to '1' in conjunction with this bit.

Note 7: Y set to '1' indicates that the information field received exceeded the maximum established information field length (N201) of the CE side or network side reporting the rejection condition.

Note 8: Z set to '1' indicates that the control field received and returned in octets 5 and 6 contained an invalid N(R).

Note 9: Octet 7 bit 1 and octet 9 bits 5 through 8 **shall** be set to '0'.

5.3.2.4 **Elements for Layer–to–Layer Communication**

5.3.2.4.1 **General**

5.3.2.4.1.1 **Primitives**

5.3.2.4.1.1.1 Communications between layers and between the data link layer and the layer management are accomplished by means of primitives.

5.3.2.4.1.1.2 Primitives represent, in an abstract way, the logical exchange of information and control between the data link and adjacent layers. They do not specify or constrain implementations.

5.3.2.4.1.1.3 Primitives consist of commands and their respective responses associated with the services requested of a lower layer. The general syntax of a primitive is:

XX–Generic name–Type: Parameters

where XX designates the interface across which the primitive flows.

5.3.2.4.1.1.4 For this Technical Standard XX is:

(a) DL for between layer 3 and the data link layer;

(b) PH for between the data link layer and the physical layer;

(c) MDL for between the layer management and the data link layer; or

(d) MPH for between the management entity and the physical layer.

5.3.2.4.1.2 **Generic Names**

The generic name specifies the activity that should be performed. Table 13 illustrates the primitives associated with this Technical Standard. The primitive generic names that are defined in this Technical Standard are defined below:

Note: Not all primitives have associated parameters.

5.3.2.4.1.2.1 **DL–Establish**

The DL–ESTABLISH primitives are used to request, indicate and confirm the outcome of the procedures for establishing multiple frame operation.

5.3.2.4.1.2.2 **DL–Release**

The DL–RELEASE primitives are used to request, indicate and confirm the outcome of the procedures for terminating a previously established multiple frame operation or, for reporting an unsuccessful establishment attempt.

5.3.2.4.1.2.3 **DL–Data**

The DL–DATA primitives are used to request and indicate layer 3 messages which are to be transmitted, or have been received by the data link layer using the acknowledged information transfer service.

5.3.2.4.1.2.4 **MDL–Error**

The MDL–ERROR primitives are used to indicate to the connection management entity that an error has occurred, associated with a previous management function request or detected as a result of communication with the data link layer peer entity, which cannot be corrected by the data link layer.

5.3.2.4.1.2.5 **PH–Data**

The PH–DATA primitives are used to request and indicate message units containing frames used for data link layer peer–to–peer communications passed to and from the physical layer.

5.3.2.4.1.3 **Primitive Types**

The primitive types defined in this Technical Standard are defined below:

5.3.2.4.1.3.1 **Request**

The REQUEST primitive type is used when a higher layer or layer management is requesting a service from the next lower layer.

5.3.2.4.1.3.2 **Indication**

The INDICATION primitive type is used by a layer providing a service to inform the next higher layer or layer management of activities within the layer.

5.3.2.4.1.3.3 **Response**

The RESPONSE primitive type is used by layer management entity as a consequence of the INDICATION primitive type.

5.3.2.4.1.3.4 **Confirm**

The CONFIRM primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

Figure 7 illustrates the relationship of the primitive types to the layer 3 and the data link layer.

5.3.2.4.1.4 **Parameter Definition**

5.3.2.4.1.4.1 **Priority Indicator**

Generally, since several SAPs may exist on the network side or CE side, protocol messages units sent by one SAP may contend with those of other service access points for the physical resources available for message transfer. The priority indicator is used to determine which message unit will have greater priority when contention exists. The priority indicator is only needed at the CE side to distinguish message units sent by the SAP with a SAPI value of '0' from all other message units.

In this Technical Standard as only one SAP will exist, no contention will exist.

5.3.2.4.1.4.2 **Message Unit**

The message unit contains additional layer–to–layer information concerning actions and results associated with requests. In the case of the DATA primitives, the message unit contains the requesting layer peer–to–peer message. For example, the DL–DATA message unit contains layer 3 information. The PH–DATA message unit contains the data link layer frame.

The operation across the data link layer/layer 3 boundary **shall** be such that the layer sending the DL–DATA primitive can assume a temporal order of the bits within the message unit and that the layer receiving the primitive can reconstruct the message with its assumed temporal order.

Table 13
Primitives Associated with the Data Link Layer

Generic Name		Type				Parameters		Message Unit Contents
		Request	Indication	Response	Confirm	Priority Indicator	Message Unit	
L3 – L2	DL– Establish	X	X	–	X	–	–	
	DL – Release	X	X	–	X	–	–	
	DL – Data	X	X	–	–	–	X	Layer 3 peer–to–peer message
M – L2	MDL – Error	–	X	X	–	–	X	Reason for error message
L2 – L1	PH – Data	X	X	–	–	X	X	Data link layer peer–to–peer message

X: Applicable – Not Applicable

L3↔L2: Layer 3/data link layer boundary L2↔L1: Data link layer/physical layer boundary

M↔L2: Management entity/data link layer boundary

5.3.2.4.2 **Primitive Procedures**

5.3.2.4.2.1 **General**

5.3.2.4.2.1.1 Primitive procedures specify the interactions between adjacent layers to invoke and provide a service. The service primitives represent the elements of the procedures.

5.3.2.4.2.1.2 In the scope of this Technical Standard the interactions between layer 3 and the data link layer are specified.

5.3.2.4.2.2 **Layer 3 – Data Link Layer Interactions**

5.3.2.4.2.2.1 The states of a data link connection endpoint may be derived from the internal states of the data link layer entity supporting this type of a data link connection.

5.3.2.4.2.2.2 The states of a point–to–point data link connection endpoint are:

(a) the LINK CONNECTION RELEASED state;

(b) the AWAITING ESTABLISH state;

(c) the AWAITING RELEASE state; and

(d) the LINK CONNECTION ESTABLISHED state.

5.3.2.4.2.2.3 The primitives provide the procedural means to specify conceptually how a data link service user can invoke a service.

5.3.2.4.2.2.4 Clause 5.3.2.4.2.2 defines the constraints on the sequences in which the primitives may occur. The sequences are related to the states at one point–to–point data link connection endpoint.

5.3.2.4.2.2.5 The possible overall sequences of primitives at a point–to–point data link connection endpoint are defined in the state transition diagram, Figure 8. The LINK CONNECTION RELEASED and LINK CONNECTION ESTABLISHED states are stable states whilst the AWAITING ESTABLISH and AWAITING RELEASE states are transition states.

5.3.2.5 **Peer–to–Peer Procedures of the Data Link Layer**

5.3.2.5.1 **Elements**

The elements of procedure (frame types) for multiple frame acknowledged information transfer (Clauses 5.3.2.5.4 to 5.3.2.5.7) which apply are:

SABME–command

UA–response

DM–response

DISC–command

RR–command/response

RNR–command/response

REJ–command/response

I–command

FRMR–response.

5.3.2.5.2 **Procedure for the Use of the P/F Bit**

5.3.2.5.2.1 **Acknowledged Multiple Frame Information Transfer**

5.3.2.5.2.1.1 A data link layer entity receiving an SABME, DISC, RR, RNR, REJ or I frame, with the P bit set to '1', **shall** set the F bit to '1' in the next response frame it transmits, as defined in Table 14.

Table 14
Immediate Response Operation of P/F Bit

Command received with P bit = '1'	Response transmitted with F bit = '1'
SABME, DISC	UA,DM
I, RR, RNR, REJ	RR, RNR, REJ, (Note)

Note: A LAPD data link layer entity may transmit an FRMR or DM response with the F bit set to '1' in response to an I frame or supervisory command with the P bit set to '1'.

5.3.2.5.3 **Automatic Negotiation of Data Link Layer Parameter Values**

The automatic negotiation of data link layer parameter values **shall not** be supported on the network side of the layer 2 link.

5.3.2.5.4 **Procedures for Establishment and Release of Multiple Frame Operation**

5.3.2.5.4.1 **Establishment of Multiple Frame Operation**

5.3.2.5.4.1.1 **General**

These procedures **shall** be used to establish multiple frame operation between the network and a designated CE entity.

Layer 3 will request establishment of the multiple frame operation by the use of the DL–ESTABLISH–REQUEST primitive. Re–establishment may be initiated as a result of the data link layer procedures defined in Clause 5.3.2.5.6. All frames other than unnumbered frame formats received during the establishment procedures **shall** be ignored.

5.3.2.5.4.1.2 **Establishment Procedures**

A data link layer entity **shall** initiate a request for the multiple frame operation to be set by transmitting the Set Asynchronous Balanced Mode Extended (SABME) command. All existing exception conditions **shall** be cleared, the retransmission counter **shall** be reset, and timer T200 **shall** then be started (timer T200 is defined in Clause 5.3.2.5.8.2. All mode setting commands **shall** be transmitted with the P bit set to '1'.

Layer 3 initiated establishment procedures imply the discarding of all outstanding DL–DATA–REQUEST primitives and all I frames in queues.

A data link layer entity receiving an SABME command, if it is able to enter the multiple–frame–established state, **shall**:

(a) respond with an Unnumbered Acknowledgement (UA) response with the F bit set to the same binary value as the P bit in the received SABME command;

(b) set the send state variable V(S), receive state variable V(R) and acknowledge state variable V(A) to 0;

(c) enter the multiple–frame–established state and inform layer 3 using the DL–ESTABLISH–INDICATION primitive;

(d) clear all existing exception conditions;

(e) clear any existing peer receiver busy condition; and

(f) start timer T203. (Refer to Clause 5.3.2.5.8.6).

If the data link layer entity is unable to enter the multiple–frame–established state, it **shall** respond to the SABME command with a DM response with the F bit to the same binary value as the P bit in the received SABME command.

Upon reception of the UA response with the F bit set to '1', the originator of the SABME command **shall**:

(a) reset timer T200;

(b) start timer T203;

(c) set the send state variable V(S), receive state variable V(R), and acknowledge state variable V(A) to 0; and

(d) enter the multiple–frame–established state and inform layer 3 using the DL–ESTABLISH–CONFIRM primitive.

Upon reception of a DM response with the F bit set to '1', the originator of the SABME command **shall** indicate this to layer 3 by means of the

DL–RELEASE–INDICATION primitive and reset timer T200. It **shall** then enter the TEI–assigned state. DM responses with the F bit set to '0' **shall** be ignored in this case.

A DL–RELEASE–REQUEST primitive received during data link layer initiated re–establishment **shall** be serviced on completion of the establishment mode–setting operation.

5.3.2.5.4.1.3 **Procedure on Expiry of Timer T200**

If timer T200 expires before the UA or DM response with the F bit set to '1' is received the data link layer entity **shall**:

(a) retransmit the SABME command as above;

(b) restart timer T200; and

(c) increment the retransmission counter.

After retransmission of the SABME command N200 times, the data link layer entity **shall** indicate this to layer 3 and the connection management entity by means of the DL–RELEASE–INDICATION and MDL–ERROR–INDICATION primitives, respectively, and enter the TEI–assigned state, after discarding all outstanding DL–DATA–REQUEST primitives and all I frames in queue.

The value of N200 is defined in Clause 5.3.2.5.8.3.

5.3.2.5.4.2 **Information Transfer**

5.3.2.5.4.2.1 Having either transmitted the UA response to a received SABME command or received the UA response to a transmitted SABME command, I frames and supervisory frames **shall** be transmitted and received according to the procedures described in Clause 5.3.2.5.5.

5.3.2.5.4.2.2 If an SABME command is received while in the multiple–frame–established state, the data link layer entity **shall** conform to the re–establishment procedure described in Clause 5.3.2.5.6.

5.3.2.5.4.3 **Termination of Multiple Frame Operation**

5.3.2.5.4.3.1 **General**

These procedures **shall** be used to terminate the multiple frame operation between the network and a designated CE entity.

Layer 3 will request termination of the multiple frame operation by use of the

DL–RELEASE–REQUEST primitive.

All frames other than unnumbered frames received during the release procedures **shall** be ignored.

All outstanding DL–DATA–REQUEST primitives and all I frames in queues **shall** be discarded.

5.3.2.5.4.3.2 **Release Procedure**

A data link layer entity **shall** initiate a request for release of the multiple frame operation by transmitting the Disconnect (DISC) command with the P bit set to '1'. Timer T200 **shall** then be started and the retransmission counter reset.

A data link layer entity receiving a DISC command while in the Multiple–Frame–Established state or Timer Recovery state **shall** transmit a UA response with the F bit set to the same binary value as the P bit in the received DISC command. A

DL–RELEASE–INDICATION primitive **shall** be passed to layer 3, and the TEI–assigned state **shall** be entered.

If the originator of the DISC command receives either:

(a) a UA response with the F bit set to '1'; or

(b) a DM response with the F bit set to '1', indicating that the peer data link layer entity is already in the TEI–assigned state, it **shall** enter the TEI–assigned state and reset timer T200.

The data link layer entity which issued the DISC command is now in the TEI–assigned state and will notify layer 3 by means of the DL–RELEASE–CONFIRM primitive. The conditions relating to this state are defined in Clause 5.3.2.5.4.4.

5.3.2.5.4.3.3 **Procedure on Expiry of Timer T200**

If timer T200 expires before a UA or DM response with the F bit set to '1' is received, the originator of the DISC command **shall**:

(a) retransmit the DISC command as defined in Clause 5.3.2.5.3.6.4;

(b) restart timer T200; and

(c) increment the retransmission counter.

If the data link layer entity has not received the correct response as defined in Clause 5.3.2.5.3.6.4, after N200 attempts to recover, the data link layer entity **shall** indicate this to the connection management entity by means of the

MDL–ERROR–INDICATION primitive, enter the TEI–assigned state and notify layer 3 by means of the DL–RELEASE–CONFIRM primitive.

5.3.2.5.4.4 TEI–Assigned State

While in the TEI–assigned state:

(a) the receipt of a DISC command **shall** result in the transmission of a DM response with the F bit set to the value of the received P bit;

(b) on receipt of an SABME command, the procedures defined in Clause 5.3.2.5.4.1 **shall** be followed;

(c) on receipt of an unsolicited DM response with the F bit set to '0', the data link layer entity **shall** initiate the establishment procedures by the transmission of an SABME (see Clause 5.3.2.5.4.1.2); otherwise the DM **shall** be ignored;

(d) on receipt of any unsolicited UA response, the data link layer entity **shall** issue an MDL–ERROR–INDICATION primitive; and

(e) all other frame types **shall** be discarded.

5.3.2.5.4.5 Collision of Unnumbered Commands and Responses

5.3.2.5.4.5.1 Identical Transmitted and Received Commands

If the transmitted and received unnumbered commands (SABME or DISC) are the same, the data link layer entities **shall** send the UA response at the earliest possible opportunity. The indicated state **shall** be entered after receiving the UA response. The data link layer entity **shall** notify layer 3, by means of the appropriate confirm primitive.

5.3.2.5.4.5.2 Different Transmitted and Received Commands

If the transmitted and received unnumbered commands (SABME or DISC) are different, the data link layer entities **shall** issue a DM response at the earliest possible opportunity. Upon receipt of a DM response with the F bit set to '1', the data link layer **shall** enter the TEI–assigned state and notify layer 3 by means of the appropriate primitive. The entity receiving the DISC command will issue a

DL–RELEASE–INDICATION primitive, while the other entity will issue a DL–RELEASE–CONFIRM primitive.

5.3.2.5.4.6 Unsolicited DM Response and SABME or DISC Command

When a DM response with the F bit set to '0' is issued by a data link layer entity, a collision between an SABME or DISC command and the unsolicited DM response may have occurred. This is typically caused by a CE applying a protocol procedure according to ITU–T Rec. X.25 LAPB [67] to ask for a mode–setting command.

In order to avoid misinterpretation of the DM response received, a data link layer entity **shall** always send its SABME or DISC command with the P bit set to '1'.

A DM response with the F bit set to '0' colliding with an SABME or DISC command **shall** be ignored.

5.3.2.5.5 **Procedures for Information Transfer in Multiple Frame Operation**

5.3.2.5.5.1 **Transmitting I Frame**

Information received by the data link layer entity from layer 3 by means of a

DL–DATA–REQUEST primitive **shall** be transmitted in an I frame. The control field parameters N(S) and N(R) **shall** be assigned the values of the send and receive state variables V(S) and V(R), respectively. The value of the send state variable V(S) **shall** be incremented by 1 at the end of the transmission of the I frame.

If timer T200 is not running at the time of transmission of an I frame, it **shall** be started. If timer T200 expires, the procedures defined in Clause 5.3.2.5.5.7 **shall** be followed.

If the send state variable V(S) is equal to V(A) plus k (where k is the maximum number of outstanding I frames (see Clause 5.3.2.5.8.5), the data link layer entity **shall** not transmit any new I frames, but may retransmit an I frame as a result of the error recovery procedures as described in Clauses 5.3.2.5.5.4 and 5.3.2.5.5.7.

When the network side or CE side is in the own receiver busy condition, it may still transmit I frames, provided that a peer receiver busy condition does not exist.

DL–DATA–REQUEST primitives received whilst in the timer recovery condition **shall** be queued.

Note: The term 'transmission of I frame' refers to the delivery of an I frame by the data link layer to the physical layer.

5.3.2.5.5.2 **Receiving I Frames**

Independent of a timer recovery condition, when a data link layer entity is not in an own receiver busy condition and receives a valid I frame whose send sequence number is equal to the current receive state variable V(R), the data link layer entity **shall**:

(a) pass the information field of this frame to layer 3 using the DL–DATA–INDICATION primitive; and

(b) increment by 1 its receive state variable V(R), and act as indicated below.

5.3.2.5.5.2.1 **P Bit Set to '1'**

If the P bit of the received I frame was set to '1', the data link layer entity **shall** respond to its peer in one of the following ways:

(a) if the data link layer entity receiving the I frame is still not in an own receiver busy condition, it **shall** send an RR response with the F bit set to '1'; or

(b) if the data link layer entity receiving the I frame enters the own receiver busy condition upon receipt of the I frame, it **shall** send an RNR response with the F bit set to '1'.

5.3.2.5.5.2.2 **P Bit Set to '0'**

If the P bit of the received I frame was set to '0' and:

(a) if the data link layer entity is still not in an own receiver busy condition:

(i) if no I frame is available for transmission or if an I frame is available for transmission but a peer receiver busy condition exists, the data link layer entity **shall** transmit an RR response with the F bit set to '0'; or

(ii) if an I frame is available for transmission and no peer receiver busy condition exists, the data link layer entity **shall** transmit the I frame with the value of N(R) set to the current value of V(R) as defined in Clause 5.3.2.5.5.1; or

(b) if, on receipt of this I frame, the data link layer entity is now in an own receiver busy condition, it **shall** transmit an RNR response with the F bit set to '0'.

When the data link layer entity is in an own receiver busy condition, it **shall** process any received I frame according to Clause 5.3.2.5.5.6.

5.3.2.5.5.3 **Sending and Receiving Acknowledgements**

5.3.2.5.5.3.1 **Sending Acknowledgements**

Whenever a data link layer entity transmits an I frame or a supervisory frame the value of N(R) **shall** be set equal to the value of V(R).

5.3.2.5.5.3.2 **Receiving Acknowledgement**

On receipt of a valid I frame or supervisory frame (RR,RNR, or REJ), even in the own receiver busy, or timer recovery conditions, the data link layer entity **shall** treat the N(R) contained in this frame as an acknowledgement for all the I frames it has transmitted with an N(S) up to and including the received N(R) – 1. The value of the acknowledge state variable V(A) **shall** be set to the value of N(R). The data link layer entity **shall** reset the timer T200 on receipt of a valid I frame or supervisory frame with the N(R) higher than V(A) (actually acknowledging some I frames), or an REJ frame with an N(R) equal to the V(A).

If a supervisory frame with the P bit set to '1' has been transmitted and not acknowledged, timer T200 **shall not** be reset.

Upon receipt of a valid I frame, timer T200 **shall not** be reset if the data link layer entity is in the peer receiver busy condition.

If timer T200 has been reset by the receipt of an I, RR, or RNR frame, and if there are outstanding I frames still unacknowledged, the data link layer entity **shall** restart timer T200. If timer T200 then expires, the data link layer entity **shall** follow the recovery procedure as defined in Clause 5.3.2.5.5.7 with respect to the unacknowledged I frames. If timer T200 has been reset by the receipt of an REJ frame, the data link layer entity **shall** follow the retransmission procedures in Clause 5.3.2.5.5.4.

5.3.2.5.5.4 **Receiving REJ Frames**

5.3.2.5.5.4.1 On receipt of a valid REJ frame, the data link layer entity **shall** act as follows:

(a) if it is not in the timer recovery condition:

(i) clear an existing peer receiver busy condition;

(ii) set its send state variable V(S) and its acknowledge state variable V(A) to the value of the N(R) contained in the REJ frame control field;

(iii) stop timer T200;

(iv) start timer T203;

(v) if it was a REJ command frame with the P bit set to 1, transmit an appropriate supervisory response with the F bit set to 1 (see Note 2 in Clause 5.3.2.5.5.5);

(vi) transmit the corresponding I frame as soon as possible, as defined in Clause 5.3.2.5.5.1, taking into account the items (1) to (3) below and the paragraph following items (1) to (3) below; and

(vii) notify a protocol violation to the connection management entity by means of the MDL–ERROR–INDICATION primitive, if it was a REJ response frame with the F bit set to '1'.

(b) if it is in the timer recovery condition and it was a REJ response frame with the F bit set to '1':

(i) clear an existing peer receiver busy condition;

(ii) set its send state variable V(S) and its acknowledge state variable V(A) to the value N(R) contained in the REJ frame control field;

(iii) stop timer T200;

(iv) start timer T203;

(v) enter the multiple–frame–established state; and

(vi) transmit the corresponding I frame as soon as possible, as defined in Clause 5.3.2.5.4.1, taking into account the items (1) to (3) below and the paragraph following items (1) to (3) below.

(c) if it is in the timer recovery condition and it was a REJ frame other than a REJ response frame with the F bit set to '1':

(i) clear an existing peer receiver busy condition;

(ii) set its acknowledge state variable V(A) to the value of the N(R) contained in the REJ frame control field; and

(iii) if it was a REJ command frame with the P bit set to '1', transmit an appropriate supervisory response frame with the F bit set to '1' (see Note 2 in Clause 5.3.2.5.5.5).

5.3.2.5.5.4.2 Transmission of I frames shall take account of the following:

(a) if the data link layer entity is transmitting a supervisory frame when it receives the REJ frame, it **shall** complete that transmission before commencing transmission of the requested I frame;

(b) if the data link layer is transmitting an SABME, a DISC command, a UA response, or a DM response when it receives the REJ frame, it **shall** ignore the request for retransmission; and

(c) if the data link layer entity is not transmitting a frame when the REJ is received, it **shall** immediately commence transmission of the requested I frame.

5.3.2.5.5.4.3 All outstanding unacknowledged I frames, commencing with the I frame identified in the received REJ frame **shall** be transmitted. Other I frames not yet transmitted may be transmitted following the retransmitted I frames.

5.3.2.5.5.5 **Receiving RNR Frames**

5.3.2.5.5.5.1 After receiving a valid RNR command or response, if the data link layer entity is not engaged in a mode–setting operation, it **shall** set a peer receiver busy condition and then:

(a) if it was an RNR command with the P bit set to '1', it **shall** respond with an RR response with the F bit set to '1' if the data link layer entity is not in an own receiver busy condition, and **shall** respond with an RNR response with the F bit set to '1' if the data link layer entity is in an own receiver busy condition; and

(b) if it was an RNR response with the F bit set to '1', an existing timer recovery condition **shall** be cleared and the N(R) contained in this RNR response **shall** be used to update the send state variable V(S).

5.3.2.5.5.5.2 The data link layer entity **shall** take note of the peer receiver busy condition and not transmit any I frames to the peer which has indicated the busy condition.

Note: The N(R) in any RR command or RNR command frame irrespective of the setting of the P bit will not be used to update V(S).

5.3.2.5.5.5.3 The data link layer entity **shall** then:

(a) treat the receive sequence number N(R) contained in the received RNR frame as an acknowledgement for all the I frames that have been (re)transmitted with an N(S) up to and including N(R) minus 1, and set its acknowledge state variable V(A) to the value of the N(R) contained in the RNR frame; and

(b) restart timer T200 unless a supervisory response frame with the F bit set to '1' is still expected.

5.3.2.5.5.5.4 If timer T200 expires, the data link layer entity **shall**:

(a) if it is not yet in a timer recovery condition, enter the timer recovery condition and reset the retransmission count variable; or

(b) if it is already in a timer recovery condition add one to its retransmission count variable.

5.3.2.5.5.5.5 If the value of the retransmission count variable is less than N200, the data link layer entity **shall**:

(a) transmit an appropriate supervisory command (see Note 2) with the P bit set to '1'; and

(b) restart timer T200.

5.3.2.5.5.5.6 If the value of the retransmission count variable is equal to N200, the data link layer **shall** initiate a re–establishment procedures as defined in Clause 5.3.2.5.6, and indicate this by means of the MDL–ERROR–INDICATION primitive to the connection management entity.

5.3.2.5.5.5.7 The data link layer entity receiving the supervisory command frame with the P bit set to '1' **shall** respond, at the earliest opportunity, with an appropriate supervisory response frame (see Note 2) with the F bit set to '1', to indicate whether or not its own receiver busy condition still exists.

5.3.2.5.5.5.8 Upon receipt of the supervisory response with the F bit set to '1', the data link layer entity **shall** reset timer T200, and:

(a) if the response is an RR or REJ response, the peer receiver busy condition is cleared and the data link layer entity may transmit new I frames or retransmit I frames as defined in Clauses 5.3.2.5.5.1 or 5.3.2.5.5.4, respectively; or

(b) if the response is an RNR response, the data link layer entity receiving the response **shall** proceed according to this Clause 5.3.2.5.5, first paragraph.

5.3.2.5.5.5.9 If a supervisory command (RR, RNR, or REJ) with the P bit set to '0' or '1', or a supervisory response frame (RR, RNR, or REJ) with the F bit set to '0' is received during the inquiry process, the data link layer entity **shall**:

(a) if the supervisory frame is an RR or REJ command frame or an RR or REJ response frame with the F bit set to '0', clear the peer receiver busy condition and if the supervisory frame received was a command with the P bit set to '1', transmit the appropriate supervisory response frame (see Note 2) with the F bit set to '1'. However, the transmission or retransmission of I frames **shall not** be undertaken until the appropriate supervisory response frame with the F bit set to '1' is received; or

(b) if the supervisory frame is an RNR command frame or an RNR response frame with the F bit set to '0', retain the peer receiver busy condition and if the supervisory frame received was an RNR command with P bit set to '1', transmit the appropriate supervisory response frame (see Note 2) with the F bit set to '1'. The inquiry of the peer status **shall** be repeated following the expiry of timer T200, or after expiry of timer T200 following the receipt of the RNR response with the F bit set to '1'.

Upon receipt of an SABME command, the data link layer entity **shall** clear the peer receiver busy condition.

Note 1: If the data link layer entity is not in an own receiver busy condition and is in a Reject exception condition (that is an N(S) sequence error has been received and a REJ frame has been transmitted, but the requested I frame has not been received), the appropriate supervisory frame is the RR frame.

Note 2: If the data link layer entity is not in an own receiver busy condition but is in an N(S) sequence error exception condition (that is an N(S) sequence error has been received but a REJ frame has not been transmitted); the appropriate supervisory frame is the REJ frame.

Note 3: If the data link layer entity is in its own receiver busy condition, the appropriate supervisory frame is the RNR frame.

Note 4: Otherwise, the appropriate supervisory frame is the RR frame.

5.3.2.5.5.6 Data Link Layer Own Receiver Busy Condition

When the data link layer entity enters an own receiver busy condition, it **shall** transmit an RNR frame at the earliest opportunity.

The RNR frame may be either:

(a) an RNR response with the F bit set to '0'; or

(b) if this condition is entered on receiving a command frame with the P bit set to '1', an RNR response with the F bit set to '1'; or

(c) if this condition is entered on expiry of timer T200, an RNR command with the P bit set to '1'.

All received I frames with the P bit set to '0' **shall** be discarded, after updating the acknowledge state variable V(A).

All received supervisory frames with the P/F bit set to '0' **shall** be processed, including updating the acknowledge state variable V(A).

All received I frames with the P bit set to '1' **shall** be discarded, after updating the acknowledge state variable V(A). However, an RNR response frame with the F bit set to '1' **shall** be transmitted.

All received supervisory frames with the P bit set to '1' **shall** be processed including updating the acknowledge state variable V(A). An RNR response with the F bit set to '1' **shall** be transmitted.

To indicate to the peer data link layer entity the clearance of the own receiver busy condition, the data link layer entity **shall** transmit an RR frame or, if a previously detected N(S) sequence error has not yet been reported, an REJ frame with the N(R) set to the current value of the receive state variable V(R).

The transmission of an SABME command or a UA response (in reply to an SABME command) also indicates to the peer data link layer entity the clearance of the own receiver busy condition.

5.3.2.5.5.7 **Waiting Acknowledgement**

5.3.2.5.5.7.1 The data link layer entity **shall** maintain an internal retransmission count variable.

If timer T200 expires, the data link layer entity **shall**:

(a) if it is not yet in the timer recovery condition, enter the timer recovery condition and reset the retransmission count variable; or

(b) if it is already in the timer recovery condition, add one to its retransmission count variable.

5.3.2.5.5.7.2 If the value of the retransmission count variable is less than N200, the data link layer entity **shall** restart timer T200; and

(a) transmit an appropriate supervisory command (see Note 2 in Clause 5.3.2.5.5.5) with the P bit set to '1'; or

(b) retransmit the last transmitted I frame (V(S) – 1) with the P bit set to '1'.

5.3.2.5.5.7.3 If the value of the retransmission count variable is equal to N200, the data link layer **shall** initiate a re–establishment procedure as defined in Clause 5.3.2.5.6 and indicate this by means of the MDL–ERROR–INDICATION primitive to the connection management entity.

5.3.2.5.5.7.4 The timer recovery condition is cleared when the data link layer entity receives a valid supervisory response frame with the F bit set to '1'. If the received supervisory frame N(R) is within the range from its current acknowledge state variable V(A) to its current send state variable V(S) inclusive, it **shall** set its send state variable V(S) to the value of the received N(R). Timer T200 **shall** be reset if the received supervisory frame response is an RR or REJ response, and then the data link layer entity **shall** resume with I frame transmission or retransmission as appropriate. Timer T200 **shall** be reset and restarted if the received supervisory response is an RNR response, to proceed with the enquiry process according to Clause 5.3.2.5.5.5.

5.3.2.5.6 Re–Establishment of Multiple Frame Operation

5.3.2.5.6.1 Criteria for Re–Establishment

The criteria for re–establishing the multiple frame operation are defined in this Clause by the following conditions:

(a) the receipt, while in the multiple–frame mode of operation of an SABME;

(b) the receipt of a DL–ESTABLISH–REQUEST primitive from layer 3 (see Clause 5.3.2.5.4.1.1);

(c) the occurrence of N200 retransmission failures while in the timer recovery condition (see Clause 5.3.2.5.5.7);

(d) the occurrence of a frame rejection condition as identified in Clause 5.3.2.7.5;

(e) the receipt, while in the multiple–frame mode of operation, of an FRMR response frame (see Clause 5.3.2.5.7.6);

(f) the receipt, while in the multiple–frame mode of operation, of an unsolicited DM response with the F bit set to '0' (see Clause 5.3.2.5.7.7);

(g) the receipt, while in the timer–recovery condition, of a DM response with the F bit set to '1'.

5.3.2.5.6.2 Procedures

In all re–establishment situations, the data link layer entity **shall** follow the procedures defined in Clause 5.3.2.5.4.1. All locally generated conditions for re–establishment will cause the retransmission of the SABME.

In the case of data link layer and peer initiated re–establishment, the data link layer entity **shall** also:

(a) issue an MDL–ERROR–INDICATION primitive to the connection management entity; and

(b) if there are any outstanding unacknowledged I frames (V(S) not equal to V(A)) prior to re–establishment, issue a DL–ESTABLISH–INDICATION primitive to layer 3, and discard all I frames in queues.

In case of layer 3 initiated re–establishment or if a DL–ESTABLISH–REQUEST primitive occurs pending re–establishment, the DL–ESTABLISHMENT–CONFIRM primitive **shall** be used.

5.3.2.5.7 Exception Condition Reporting and Recovery

Exception conditions may occur as the result of physical layer errors or data link layer procedural errors.

The error recovery procedures which are available to effect recovery following the detection of an exception condition at the data link layer are defined in Clauses 5.3.2.5.7.1 to Clause 5.3.2.5.7.7.

5.3.2.5.7.1 N(S) Sequence Error

An N(S) sequence error exception condition occurs in the receiver when a valid I frame is received which contains an N(S) value which is not equal to the receive state variable V(R) at the receiver. The information field of all I frames whose N(S) does not equal the receive state variable V(R) **shall** be discarded.

The receiver **shall not** acknowledge (nor increment its receive state variable) the I frame causing the sequence error, nor any I frames which may follow, until an I frame with the correct N(S) is received.

A data link layer entity which receives one or more I frames having sequence errors but otherwise error–free, or subsequent supervisory frames (RR, RNR, and REJ), **shall** use the control field information contained in the N(R) field and the P or F bit to perform data link control functions; for example, to receive acknowledgement of previously transmitted I frames and to cause the data link layer entity to respond if the P bit is set to '1'. Therefore, the retransmitted I frame may contain an N(R) field value and a P bit that are updated from, and therefore different from, the ones contained in the originally transmitted I frame.

The REJ frame is used by a receiving data link layer entity to initiate an exception condition recovery (retransmission) following the detection of an N(S) sequence error.

Only one REJ exception condition for a given direction of information transfer **shall** be established at a time.

A data link layer entity receiving a REJ command or response **shall** initiate sequential transmission (retransmission) of I frames starting with the I frame indicated by the N(R) contained in the REJ frame.

A REJ exception condition is cleared when the requested I frame is received or when an SABME or DISC command is received.

5.3.2.5.7.2 **N(R) Sequence Error**

An N(R) sequence error exception condition occurs in the transmitter when a valid supervisory frame or I frame is received which contains an invalid N(R) value.

A valid N(R) is one that is in the range between V(A) and V(S).
(See Clause 5.3.2.3.5.2.3)

The information field contained in an I frame which is correct in sequence and format may be delivered to layer 3 by means of the DL–DATA–INDICATION primitive.

The data link layer entity **shall** inform the connection management entity of this exception condition by means of the MDL–ERROR–INDICATION primitive, and initiate re–establishment according to Clause 5.3.2.3.5.2.

5.3.2.5.7.3 **Timer Recovery Condition**

If a data link layer entity, due to a transmission error, does not receive a single I frame or the last I frame(s) in a sequence of I frames, it **shall not** detect an out–of–sequence exception condition and therefore **shall not** transmit a REJ frame.

The data link layer entity which transmitted the unacknowledged I frame(s) **shall**, on the expiry of timer T200, take appropriate recovery action as defined in Clause 5.3.2.5.5.7 to determine at which I frame retransmission must begin.

5.3.2.5.7.4 **Invalid Frame Condition**

Any frame received which is invalid (as defined in Clause 5.3.2.2.9) **shall** be discarded, and no action **shall** be taken as a result of that frame.

5.3.2.5.7.5 **Frame Rejection Condition**

A frame rejection condition results from one of the conditions described in Clause 5.3.2.3.6.10.

Upon occurrence of a frame rejection condition, the data link layer entity **shall**:

(a) issue an MDL–ERROR–INDICATION primitive; and

(b) initiate re–establishment (see Clause 5.3.2.5.6.2)

5.3.2.5.7.6 **Receipt of an FRMR Response Frame**

Upon receipt of an FRMR response frame in the multiple–frame mode of operation, the data link layer entity **shall**:

(a) issue an MDL–ERROR–INDICATION Primitive; and

(b) initiate re–establishment (see Clause 5.3.2.5.6.2).

5.3.2.5.7.7 **Unsolicited Response Frames**

The action to be taken on the receipt of an unsolicited response frame is defined in Table 15.

Table 15
Action to be Taken on the Receipt of an Unsolicited Response Frame

	State				
	TEI Assigned State 4	Awaiting Establishment State 5	Awaiting Release State 6	Multiple Frame Modes of Operation	
Unsolicited Response Frame				Established Mode State 7	Timer Recovery Condition State 8
UA Response F = 1	MEI			MEI	MEI
UA Response F = 0	MEI	MEI	MEI	MEI	MEI
DM Response F = 1	–			MEI	RE–EST MEI
DM Response F = 0	EST	–	–	RE–EST MEI	RE–EST MEI
Supervisory Response F = 1	–	–	–	MEI	
Supervisory Response F = 0	–	–	–		

Legend

MEI Send MDL–ERROR–INDICATION

– Ignore

EST Establish data link

RE–EST Re–establish data link

5.3.2.5.8 **System Parameters**

5.3.2.5.8.1 **General**

The system parameters listed are associated with each individual Service Access Point (SAP).

5.3.2.5.8.2 **Timer T200**

The default value for timer T200 at the end of which transmission of a frame may be initiated according to the procedures described in Clause 5.3.2.5.5 **shall** be one second.

5.3.2.5.8.3 **Maximum Number of Retransmissions (N200)**

The maximum number of retransmissions of a frame (N200) is a system parameter. The default value of N200 **shall** be 3.

5.3.2.5.8.4 **Maximum Number of Octets in an Information Field (N201)**

The maximum number of octets in an information field (N201) is a system parameter (See also Clause 5.3.2.2.5).

For the SAP supporting signalling, the default value **shall** be 260 octets.

5.3.2.5.8.5 **Maximum Number of Outstanding I Frames (k)**

The maximum number (k) of sequentially numbered I frames that may be outstanding (that is, unacknowledged) at any given time is a system parameter which **shall not** exceed 127, for extended (modulo 128) operation.

For this Technical Standard the default value **shall** be 7.

5.3.2.5.8.6 **Timer T203**

The default value of timer T203 **shall** be 10 seconds.

5.3.2.5.9 **Data Link Layer Monitor Function**

5.3.2.5.9.1 **General**

The procedural elements defined in Clauses 5.3.2.5.1 to 5.3.2.5.7 allow for the supervision of the data link layer resource. This Clause describes procedures which are used to provide this supervision function on the network side. The use of this function on the CE side is optional.

5.3.2.5.9.2 **Data Link Layer Supervision in the Multiple–Frame–Established State**

The connection verification is a service provided by data link layer to layer 3. This implies that layer 3 is informed in case of a failure only.

The procedure is based on supervisory command frames (RR command, RNR command) and a timer T203 and operates in the multiple–frame–established state as follows.

If there are no frames being exchanged on the data link connection (neither new nor outstanding I frames or no supervisory frames with the P bit set to '1' etc), there is no means to detect a faulty data link connection condition, or if a CE has been unplugged. Timer T203 represents the maximum time allowed without frames being exchanged.

If timer T203 expires, a supervisory command with the P bit set to 1 is transmitted. Such a procedure is protected against transmission errors, by making use of the normal timer T200 procedure including retransmission count and N200 attempts.

5.3.2.5.9.3 **Connection Verification Procedures**

5.3.2.5.9.3.1 **Start of Timer T203**

Timer T203 **shall** be started:

(a) when the multiple–frame–established state is entered; and

(b) when in the multiple–frame–established state whenever timer T200 is stopped.

Note: These two conditions mean that timer T203 is only started whenever timer T200 is stopped and not restarted.

Upon receiving an I or supervisory frame, timer T203 **shall** be restarted if timer T200 is not to be started.

5.3.2.5.9.3.2 **Stop Timer T203**

Timer T203 **shall** be stopped

(a) when in the multiple–frame–established state, the timer T200 is started; and

(b) upon leaving the multiple–frame–established state.

5.3.2.5.9.3.3 **Expiry of Timer T203**

If timer T203 expires, the data link layer entity will act as follows (it should be noted that timer T200 is neither running nor expired):

(a) set the retransmission count variable to 0;

(b) enter timer recovery state;

(c) transmit a supervisory command with the P bit set to '1' as follows:

  (i) if there is not a receiver busy condition (own receiver not busy), transmit an RR command; or

  (ii) if there is a receiver busy condition (own receiver busy), transmit an RNR command;

(d) start timer T200; and

(e) send MDL–ERROR–INDICATION primitive to connection management after N200 retransmissions.

5.3.3 An SDL Representation of the Point–to–Point Procedures of the Data Link Layer Primary Rate Access

5.3.3.1 General

5.3.3.1.1 The purpose of Clause 5.3.3 is to provide one example of an SDL representation of the point–to–point procedures of the data link layer, to assist in the understanding of this standard. This representation does not describe all of the possible actions of the data link layer entity, as a non–partitioned representation was selected in order to

minimise its complexity. The SDL representation does not therefore constrain implementations from exploiting the full scope of the procedures as presented within the text of this standard. The text description of the procedures is definitive.

5.3.3.1.2 The representation is a peer–to–peer model of the point–to–point procedures of the data link layer and is applicable to the data link layer entities at both the CE and network sides. See Figure 11.

5.3.3.2 **An Overview of the States of the Point–to–Point Data Link Layer Entity**

5.3.3.2.1 The SDL representation of the point–to–point procedures are based on an expansion of the two basic states identified in Clause 5.3.1.4.2 to the following 5 states:

– State 4 : TEI assigned

– State 5 : Awaiting establishment

– State 6 : Awaiting release

– State 7 : Multiple frame established

– State 8 : Timer recovery

5.3.3.2.2 An overview of the inter–relationships of these states is provided in Figure 12. This overview is incomplete, and serves only as an introduction to the SDL representation. All data link layer entities are conceptually initiated in the TEI assigned state (state 4). The receipt of an Establish request in the TEI assigned state (state 4) **shall** cause the initiation of the establishment procedures and the transition to the Awaiting establishment state (state 5). Completion of the LAP establishment procedures takes the data link layer entity into the Multiple frame establishment state (state 7).

5.3.3.2.3 Peer initiated establishment causes a direct transition from the TEI assigned state (state 4) to the Multiple frame established state (state 7). In the Multiple frame established state (state 7), Acknowledged data transfer requests can be serviced directly subject to the restrictions of the procedures. Expiry of timer T200, which is used in both the flow control and data transfer aspects of the data link layer entity's procedures initiates the transition to the Timer recovery state (state 8). Completion of the timer recovery procedures **shall** return the data link layer entity to the Multiple frame established state (state 7). In states 7 and 8 of the SDL representation, the following conditions which are identified within the Standard are observed:

(a) Peer receiver busy

(b) Reject exception

(c) Own receiver busy

5.3.3.2.4 In addition, other conditions are used in order to avoid identification of additional states. A peer initiated LAP release will take the data link layer entity directly into

the TEI assigned state (state 4), whilst a Release request **shall** be via the Awaiting release state (state 6).

Table 16
Occurrence of MDL–Error–Indication within the Basic States

Error Code	Error Condition	Affected State
A	Receipt of unsolicited SUPERVISORY Response (F = 1)	7
B	Receipt of unsolicited DM Response (F = 1)	7, 8
C	Receipt of unsolicited UA Response (F = 1)	4, 7, 8
D	Receipt of unsolicited UA Response (F = 0)	4, 5, 6, 7, 8
E	Receipt of unsolicited DM Response (F = 0)	7, 8
F	Receipt of SABME (peer initiated re–establishment)	7, 8
G	Unsuccessful re–transmission of SABME (N200 retries)	5
H	Unsuccessful re–transmission of DISC (N200 retries)	6
I	Unsuccessful re–transmission of supervisory command (N200 retries)– STATUS ENQUIRY	8
J	Receipt of a frame with an invalid N(R)	7, 8
K	Receipt of FRMR–Response frame	7, 8
L	Receipt of a frame with a control field that is undefined or not implemented	4, 5, 6, 7, 8
M	Receipt of a frame with an information field that is not permitted	4, 5, 6, 7, 8
N	Receipt of a supervisory or unnumbered frame with incorrect length	4, 5, 6, 7, 8
O	Receipt of an I frame with an information field which exceeds the maximum established length (N201)	4, 5, 6, 7, 8

5.3.3.3 **The Use of Queues**

To enable a satisfactory representation of the data link layer entity, a conceptual queue for the I frame transmission has been explicitly brought out. This conceptual queue is finite but unbounded and should in no way restrict the implementation of the point–to–point procedures. An additional signal, I Frame Queued Up, has been provided in order to cause the servicing of this queue to be initiated

5.3.3.4 **Occurrence of MDL–ERROR–INDICATION within the Basic States**

Table 16 lists the error situations in which the MDL–ERROR INDICATION primitive is generated to notify the data link layer's connection management entity of the occurred error. Each error condition is assigned an unique error code which is used in the SDL diagrams, see Figure 13 for the point–to–point multi–frame acknowledged procedures.

5.4 Layer 3

5.4.1 General

5.4.1.1 This Clause describes the D–Channel layer 3 functions, procedures and protocols employed across the ISDN CE interface which provides the means to establish, maintain and terminate network connections across an ISDN between communicating application entities.

5.4.1.2 The procedures defined are in terms of messages exchanged over the D–Channel of a primary rate B–Channel interface structure as defined in ITU–T Rec. I.412 [34] and are, in essence, for the control of circuit–switched connections.

5.4.1.3 The layer 3 procedures use all of the functions and services provided by layer 2 as described in Clause 5.3 of this standard.

5.4.1.4 Detailed description of the procedures for call control are given in Clauses 5.4.2.4 and 5.4.2.5 in terms of the sequence of messages defined in Clause 5.4.2.2 which are transferred across the CE–network interface, and the information processing and actions that take place in the CE and the exchange in the process of call establishment and clearing. Detailed SDL diagrams for the layer 3 protocol are contained in Figure 14.

5.4.1.5 The convention adopted by this Standard is one of states and transitions. In accordance with ITU–T Rec. Z.100 [76], an entity is regarded as being in either a state (waiting to receive one of a set of signals) or in a transition (performing a sequence of actions). When in a state, an entity may only receive a specified set of signals. Receipt of one of these signals starts a transition. During a transition, information processing and actions take place (possibly including output of signals). The transition ends with the process entering a new state.

5.4.1.6 The term 'layer 3' is used for the functions and protocol described in this part of the standard. The terms 'data link layer' and 'layer 2' are used interchangeably to refer to the layer immediately below layer 3. The terms 'incoming' and 'outgoing' are used to describe the call as viewed by the CE side of the interface.

5.4.1.7 The layer 3 conformance tests that **shall** be performed on the CE to verify compliance with Clause 5.4 are contained in Clause 6.4.

5.4.2 Network Interface Specification Primary Rate Access

5.4.2.1 General

5.4.2.1.1 This Clause provides the definition for states that individual calls may have. These definitions do not apply to the state of the interface itself, any attached equipment, the D–Channel, or the logical links used for signalling on the D–Channel and do not apply to the state of the call reference. They are call states. Because several calls may exist simultaneously at the CE–network interface, and each call may be in a different state, the state of the interface itself cannot be unambiguously defined.

5.4.2.2 Message Functions Definitions and Content

5.4.2.2.1 Overview

Each definition includes:

(a) a brief description of the message use and an indication of its direction including whether the message has:

- (i) local significance, i.e. relevant only in the originating or terminating access;
- (ii) access significance, i.e. relevant in the originating and terminating access, but not in the network;
- (iii) global significance, i.e. relevant in the originating and terminating access and in the network; or
- (iv) dual significance, i.e. relevant in either the originating or terminating access, and in the network.

(b) a table listing the information elements contained in the message. For each information element, the table indicates:

- (i) the clause of this part of the standard describing the information element.
- (ii) the direction in which it may be sent; i.e. CE to network ('u n') network to CE ('n u') or both;

  Note: the CE–network terminology refers to the NT2–ET.

- (iii) whether inclusion is mandatory ('M') or optional ('O') and in some cases where there are optional information elements, a corresponding note detailing the circumstances under which the information element **shall** be included;

  Note: Even when the inclusion of a particular information element in a message is optional, that information element may be required for the correct operation of some procedures. The indication 'optional' does not imply that some implementations of this standard do not recognise these information elements, rather that these information elements may not always be present in the message.

- (iv) the length(s), in octets.

The information elements are listed in order of appearance in the message. The relative order of information element is the same for all message types.

(c) further explanatory notes, as necessary.

5.4.2.2.2 **Message Length**

The maximum message length (including all mandatory and optional information elements) is less than or equal to the maximum number of octets in an information field of a layer 2 frame (see Clause 5.3.2).

5.4.2.2.3 **Messages**

Table 17 summarizes the messages and indicates the connection type applicable.

Table 17
Messages

	Reference (Clause)
Call establishment messages:	
ALERTing	5.4.2.2.3.1
CALL PROCeeding	5.4.2.2.3.2
CONNect	5.4.2.2.3.3
CONNect ACKnowledge	5.4.2.2.3.4
PROGress	5.4.2.2.3.7
SETUP	5.4.2.2.3.12
SETUP ACKnowledge	5.4.2.2.3.13
Call disestablishment messages:	
DISConnect	5.4.2.2.3.5
RELease	5.4.2.2.3.8
RELease COMplete	5.4.2.2.3.9
RESTart	5.4.2.2.3.10
RESTart ACKnowledge	5.4.2.2.3.11
Miscellaneous messages:	
INFOrmation	5.4.2.2.3.6
STATUS	5.4.2.2.3.14
STATUS ENQUIRY	5.4.2.2.3.15

Note: RESTART is not call related, but is related to the interface or a channel within an interface.

5.4.2.2.3.1 **Alerting**

This message is sent by the called CE to the network, and by the network to the calling CE, to indicate that called CE alerting has been initiated (see Table 18).

Table 18
ALERTing Message Content

Message type: ALERTING

Direction: both

Significance: global

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Channel identification	5.4.2.3.5.9	u → n	O Note 1	2 – 5
Progress indicator	5.4.2.3.5.13	both	O Note 2	2 – 5
Display	5.4.2.3.5.10	n → u	O	2 – 34

Note 1: The channel identification information element is mandatory if this is the first message in response to a SETUP.

Note 2: For example, included if non–ISDN equipment connected to the ISDN is alerting.

5.4.2.2.3.2 **CALL PROCeeding**

This message is sent to indicate that requested call establishment has been initiated, and no more call establishment information will be accepted (see Table 19).

Table 19
CALL PROCeeding Message Content

Message type: CALL PROCEEDING

Direction: both

Significance: local

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Channel identification	5.4.2.3.5.9	both	O Note 1	2 – 5
Progress indicator	5.4.2.4.3.13	both	O Note 2	2 – 5
Display	5.4.2.3.5.10	n → u	O	2 – 34

Note 1: The channel identification information element is mandatory if this is the first message in response to a SETUP.

Note 2: Included if the sender of the message is interworking with non–ISDN equipment.

5.4.2.2.3.3 CONNECT

This message is sent by the called CE to the network, and by the network to the calling CE, to indicate call acceptance by the called CE (see Table 20).

Table 20
CONNECT Message Content

Message type: CONNECT

Direction: both

Significance: global

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Channel identification	5.4.2.3.5.8	u → n	O Note 1	2 – 5
Progress indicator	5.4.2.3.5.13	both	O Note 2	2 – 5
Display	5.4.2.4.5.10	n → u	O	2 – 34

Note 1: The channel identification information element is mandatory if this is the first message in response to a SETUP.

Note 2: Included if the called CE is non–ISDN (e.g. an analogue telephone set).

5.4.2.2.3.4 CONNect ACKnowledge

This message is sent by the network to the called CE to indicate that a connection has been established and may be sent by the calling CE to the network (see Table 21).

Table 21
CONNect ACKnowledge Message Content

Message type: CONNect ACKnowledge

Direction: both

Significance: local

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Display	5.4.2.3.5.10	n → u	O	2 – 34

5.4.2.2.3.5 **DISConnect**

This message is sent by either the CE or the network as a request to clear the call. The channel will be disconnected following the sending of this message unless the network sends the message with the indication that in–band tones or announcements are available (see Table 22).

Table 22
DISConnect Message Contents

Message type: DISConnect

Direction: both

Significance: global

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Cause	5.4.2.3.5.9	both	M	4 – 6
Progress indicator	5.4.2.3.5.13	n → u	O Note	2 – 5
Display	5.4.2.4.5.10	n → u	O	2 – 34

Note: Included when the network wishes to advise the CE that in–band tones or announcements are available.

5.4.2.2.3.6 **INFOrmation**

This message is sent from the CE to the network, or from the network to the CE, to provide additional call establishment information during overlap sending mode (i.e. additional number digits). It may also be used to provide information for facilities (see Table 23).

Table 23
INFOrmation Message Content

Message type: INFOrmation

Direction: both

Significance: local

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Display	5.4.2.3.5.10	n → u	M	2 – 34
Called party number	5.4.2.3.5.4	u → n	M	2 – 23

5.4.2.2.3.7 **PROGress**

This message is sent from the network or from the CE to indicate the progress of a call (see Table 24).

Table 24
PROGRESS Message Content

Message type: PROGress

Direction: both

Significance: global

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Progress indicator	5.4.2.3.5.13	both	M	2 – 5
Display	5.4.2.3.5.10	n → u	O	2 – 34

5.4.2.2.3.8 **RELease**

This message is sent, from either the CE or the network, to indicate that the equipment sending the message has disconnected the channel, and that the receiving equipment should release the channel and abort the call if it is in the process of being set up (see Table 25).

Table 25
RELease Message Content

Message type: RELease

Direction: both

Significance: local, global (global if used as the first clearing message)

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Cause	5.4.2.3.5.8	both	O Note	2 – 6
Display	5.4.2.3.5.10	$n \rightarrow u$	O	2 – 34

Note: The cause information element is mandatory if the RELEASE message is the first message in the clearing sequence, (i.e. first clearing entity) and in this case its minimum length is 4 octets.

5.4.2.2.3.9 **RELease COMplete**

This message is sent, from either the CE or the network, to indicate that the equipment sending the message has released the channel and is releasing the call reference. The receiving equipment should release the channel and the call reference (refer Table 26).

Table 26
RELease COMplete Message Content

Message type: RELease COMplete

Direction: both

Significance: local, global (global if used as the first clearing message).

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Cause	5.4.2.3.5.8	both	O Note	2 – 6
Display	5.4.2.3.5.10	n → u	O	2 – 34

Note: The cause information element is mandatory if the RELEASE COMPLETE message is the first message in the clearing sequence, (i.e. first clearing entity) and in this case its minimum length is 4 octets.

5.4.2.2.3.10 **REStart**

This message is sent from one side of the interface to the other to request the recipient to restart (i.e. return to an idle condition) the indicated channel(s) or interface. The REStart message is of local significance. It **shall** use the global call reference defined in Clause 5.4.2.3.3 (see Table 27).

Table 27
REStart Message Content

Message type: REStart

Direction: both

Significance: local

Information Element	**Reference**	**Direction**	**Type**	**Length**
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Channel identification	5.4.2.3.5.9	both	O Note	2 – 6
Display	5.4.2.3.5.10	n → u	O	2 – 34
Restart indicator	5.4.2.3.5.14	both	M	3

Note: Included when it is necessary to indicate the particular channel to be restarted.

5.4.2.2.3.11 REStart ACKnowledge

This message is sent to acknowledge the receipt of the REStart message and to indicate that the requested restart is complete. The REStart ACKnowledge is of local significance. It **shall** use the global call reference defined in Clause 5.4.2.3.3 (see Table 28).

Table 28
REStart ACKnowledge Message Content

Message type: REStart ACKnowledge

Direction: both

Significance: local

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Channel identification	5.4.2.3.5.9	both	O Note	2 – 5
Display	5.4.2.3.5.10	n → u	O	2 – 34
Restart indicator	5.4.2.3.5.14	both	M	3

Note: Included when it is necessary to indicate the particular channel that has been restarted.

5.4.2.2.3.12 SETUP

This message is sent, from either the CE or the network, to request call establishment (see Table 29).

Table 29
SETUP Message Content

Message type: SETUP

Direction: both

Significance: global

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Bearer capability	5.4.2.3.5.2	both	M	4 – 11
Channel identification	5.4.2.3.5.9	u → n n → u	O Note 1 M	2 – 5 3 – 5
Progress indicator	5.4.2.3.5.13	both	O Note 2	2 – 5
Display	5.4.2.3.5.10	n → u	O	2 – 34
Calling party number	5.4.2.3.5.6	both	O Note 3	2 – 24
Calling party subaddress	5.4.2.3.5.7	both	O Note 4	2 – 23
Called party number	5.4.2.3.5.4	n → u u → n	M Note 5 O	2 – 23
Called party subaddress	5.4.2.3.5.5	both	O Note 6	2 – 23
Low layer compatibility	5.4.2.3.5.12	both	O Note 7	2 – 13
High layer compatibility	5.4.2.3.5.11	both	O Note 8	2 – 4

Note 1: Included when the CE desires to indicate a channel. When not included, it is interpreted as 'any channel acceptable'. The channel identification information element in a SETUP message sent from the CE is optional.

Note 2: Included when the call originated from non–ISDN equipment.

Note 3: Included by the CE to indicate to the network the calling party number. Included by the network when the called CE requests the calling party number.

Note 4: Included by the calling CE to indicate to the called CE the calling party subaddress.

Note 5: Included to send called party number information to the CE or the network.

Note 6: Included by the calling CE to indicate to the called CE the called party subaddress.

Note 7: Included when end–to–end compatibility checking of the low layers is required.

Note 8: Included when end–to–end compatibility checking of the high layers is required.

5.4.2.2.3.13 SETUP ACKnowledge

This message is sent by the network to the calling CE to indicate call establishment has been initiated but may not proceed until additional information is received (refer Table 30).

Table 30
SETUP ACKnowledge Message Content

Message type: SETUP ACKnowledge

Direction: network to CE

Significance: local

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	n → u	M	1
Call reference	5.4.2.3.3	n → u	M	3
Message type	5.4.2.3.4	n → u	M	1
Channel identification	5.4.2.3.5.9	n → u	M	3 – 5
Progress indicator	5.4.2.3.5.13	n → u	O Note	2 – 5
Display	5.4.2.3.5.10	n → u	O	2 – 34

Note: Included in the event of interworking (e.g. non–ISDN equipment).

5.4.2.2.3.14 **STATUS**

This message may be sent from either the CE or the network at any time during a call to report an error condition or to report status of the protocol in response to a STATUS ENQUIRY message (see Table 31).

Table 31
STATUS Message Content

Message type: STATUS

Direction: both

Significance: local

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Cause	5.4.2.3.5.8	both	M	4 – 6
Call State	5.4.2.3.5.3	both	M	3
Display	5.4.2.3.5.10	n → u	O	2 – 34

5.4.2.2.3.15 **STATUS ENQUIRY**

The STATUS ENQUIRY message may be sent from either the CE or the network at any time to solicit a STATUS message (see Table 32).

Table 32
STATUS ENQUIRY Message Content

Message type: STATUS ENQUIRY

Direction: both

Significance: local

Information Element	Reference	Direction	Type	Length
Protocol discriminator	5.4.2.3.2	both	M	1
Call reference	5.4.2.3.3	both	M	3
Message type	5.4.2.3.4	both	M	1
Display	5.4.2.3.5.10	n → u	O	2 – 34

5.4.2.3 Message Format and Information Element Coding

5.4.2.3.1 Overview

5.4.2.3.1.1 The tables and text contained within Clause 5.4.2.3 describe message contents. Within each octet, the bit designated 'bit 1' is transmitted first, followed by bits 2, 3, 4, etc. Similarly, the octet shown at the top of each Table is sent first.

5.4.2.3.1.2 Within this protocol, every message consists of the following elements:

(a) protocol discriminator;

(b) call reference;

(c) message type; and

(d) other information elements, as required.

Elements (a), (b) and (c) are common to all the messages and must always be present, while elements (d) are specific to each message type. This organisation is illustrated in the example shown in Table 33.

Table 33
General Message Organisation Example

<table>
<tr><th colspan="8">Bits</th><th></th></tr>
<tr><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>Octet</th></tr>
<tr><td colspan="8">Protocol discriminator</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="4">Length of call reference value (in octets)</td><td>2</td></tr>
<tr><td colspan="8">Call reference value</td><td>3, 4</td></tr>
<tr><td>0</td><td colspan="7">Message type</td><td>etc.</td></tr>
<tr><td colspan="8">other information elements as required</td><td>etc.</td></tr>
</table>

A particular message may contain more information than the CE or the network needs or can understand. All equipment should be able to ignore any extra information present in a message which is not required for the proper operation of that equipment.

Unless specified otherwise, a particular information element may be present only once in a given message.

When a field, such as the call reference value, extends over more than one octet, the order of bit values progressively decreases as the octet number increases. The least significant bit of the field is represented by the lowest numbered bit of the highest numbered octet of the field.

5.4.2.3.2 Protocol Discriminator

The purpose of the protocol discriminator is to distinguish messages for

CE–network call control from other messages.

The protocol discriminator is the first part of every message. The protocol discriminator is coded according to Table 34.

Table 34
Protocol Discriminator

Bits 8	7	6	5	4	3	2	1	Octet
Q.931 (I.451) CE–network call control messages								
0	0	0	0	1	0	0	0	1
protocol discriminator								

All other values are reserved.

5.4.2.3.3 Call Reference

The purpose of the call reference is to identify the call or facility control request at the local CE–network interface to which the particular message applies. The call reference does not have end–to–end significance across the ISDN.

The call reference is the second part of every message and is coded as shown in Table 35. The call reference value is two octets long.

Table 35
Call Reference Information Element

Bits 8	7	6	5	4	3	2	1	Octet
0	0	0	0	Length of Call Reference value (in octets)				1
Flag	Call Reference value							2 etc.

Call Reference Flag: 0 = origination side

1 = destination side

The call reference information element comprises three fields: the length of the call reference value, the call reference flag and the call reference value.

Call reference values are assigned by the originating side of the interface for a call. These values are unique to the originating side only within the D–Channel layer 2 logical link connection. The call reference value is assigned at the beginning of a call and remains fixed for the lifetime of a call. After a call ends, the associated call

reference value may be reassigned to a later call. Two identical call reference values on the D–Channel layer two logical link connection may be used when each value pertains to a call originated at opposite ends of the link.

The call reference flag can take the values '0', or '1'. The call reference flag is used to identify which end of the layer two logical link originated a call. The originating side of the call always sets the call reference flag to '0'. The destination side of the call always sets the call reference flag to a '1'.

For example, when the CE originates a call, it assigns the call a certain call reference value. When the CE sends a message to the network equipment concerning that call, it sends the assigned call reference value plus a '0' in the call reference flag bit. Whenever the CE receives a message from the network equipment concerning the call, it receives the assigned call reference value plus a '1' in the call reference flag bit. If the CE receives a message from the network equipment with the identical call reference value it had assigned but the call reference flag is set to '0', then the CE **shall** recognise that this message concerns a call the network equipment had originated.

The call reference flag identifies who allocated the call reference value for this call and its only purpose is to resolve simultaneous attempts to allocate the same call reference value.

Note: The global call reference is represented in the call reference information element as the first octet coded '0000 0010' and the second octet coded 'X000 0000' (where 'X' is the call reference flag) and the third octet coded '0000 0000'. The equipment receiving a message containing the global call reference should interpret the message as pertaining to all call references associated with the appropriate data link connection identifier. Messages that are allowed to include the global call reference are specifically identified in Clause 5.2.2.2.3.

5.4.2.3.4 Message Type

The purpose of the message type is to identify the function of the message being sent.

The message type is the third part of every message, and is one or two octets long.

For ITU–T message types the message type information element is one octet long and is coded as shown in Table 36 and Table 37.

Table 36
ITU–T Message Type

Bits 8	7	6	5	4	3	2	1	Octet
0	Message Type							1

Note: Bit 8 is reserved for possible future use as an extension.

Table 37
ITU–T Message Types

	8	7	6	5	4	3	2	1	
	0	0	0	–	–	–	–	–	**Call establishment messages:**
01				0	0	0	0	1	– ALERTing
02				0	0	0	1	0	– CALL PROCeeding
07				0	0	1	1	1	– CONNect
0F				0	1	1	1	1	– CONNect ACKnowledge
03				0	0	0	1	1	– PROGRESS
05				0	0	1	0	1	– SETUP
0D				0	1	1	0	1	– SETUP ACKnowledge
4	0	1	0	–	–	–	–	–	**Call disestablishment message:**
45				0	0	1	0	1	– DISConnect
4D				0	1	1	0	1	– RELease
5A				1	1	0	1	0	– RELease COMplete
46				0	0	1	1	0	– RESTart
4E				0	1	1	1	0	– RESTart ACKnowledge
	0	1	1	–	–	–	–	–	**Miscellaneous messages:**
7B				1	1	0	1	1	– INFOrmation
7D				1	1	1	0	1	– STATUS
75				1	0	1	0	1	– STATUS ENQUIRY
	All other values are reserved								

5.4.2.3.5 **Other Information Elements**

5.4.2.3.5.1 **Coding Rules**

The coding of other information elements follows the coding rules described below. These rules are formulated to allow each piece of equipment which processes a message to find information elements important to it, and yet remain ignorant of information elements not important to that equipment.

Only variable length information elements are defined (see Table 38).

Note: ITU–T single length information elements are not defined in this Standard.

The coding of the information element identifier bits is summarized in Table 39.

There is a particular order of information element codesets within a message. Codesets are present in ascending numerical order, i.e. codeset 0 precedes codeset 5.

There is a particular order of appearance for each information element within a codeset in a message. The code values of the information element identifier for the variable length formats are assigned in ascending numerical order, according to the actual order of appearance of each information element in a message. This allows the receiving equipment to detect the presence or absence of a particular information element without scanning through an entire message.

Information elements using the single octet information element identifier may appear at any point in the message within their codeset.

Where the description of information elements in this part of the standard contains spare bits, these bits are indicated as being set to '0'. Messages should not be rejected simply because a spare bit is set to '1'.

The second octet of a variable length information element indicates the total length of the contents of that information element (i.e. the length starting with Octet 3). It is the binary coding of the number of octets of the contents, with bit 1 as the least significant bit (2^0).

An optional, variable length information element may be present, but empty. For example, a SETUP message may contain a called party number information element, the content of which is of zero length. This should be interpreted by the receiver as equivalent to that information element being absent. Similarly, an absent information element should be interpreted by the receiver as equivalent to that information element being empty. Mandatory and single octet information elements cannot be empty.

Table 38
Format of Information Elements

Bits

8	7	6	5	4	3	2	1	Octet
0	Information Element Identifier							1
Length of Information Element Contents (octets)								2
Contents of Information element								3

Table 39
Information Element Identifier Coding for Codeset 0

	8	7	6	5	4	3	2	1		Clause Reference
	1	:	:	:	–	–	–	–	Single octet information elements:	
		0	0	0	–	–	–	–	Reserved	
	0	:	:	:	:	:	:	:	Variable length information elements:	
04		0	0	0	0	1	0	0	Bearer capability	5.4.2.3.5.2
08		0	0	0	1	0	0	0	cause (Note)	5.4.2.3.5.8
14		0	0	1	0	1	0	0	call state	5.4.2.3.5.3
18		0	0	1	1	0	0	0	channel identification	5.4.2.3.5.9
1E		0	0	1	1	1	1	0	progress indicator	5.4.2.3.5.13
28		0	1	0	1	0	0	0	Display	5.4.2.3.5.10
6C		1	1	0	1	1	0	0	calling party number	5.4.2.3.5.6
6D		1	1	0	1	1	0	0	calling party subaddress	5.4.2.3.5.7
70		1	1	1	0	0	0	0	called party number	5.4.2.3.5.4
71		1	1	0	0	0	0	1	called party subaddress	5.4.2.3.5.5
79		1	1	1	1	0	0	1	restart indicator	5.4.2.3.5.14
7C		1	1	1	1	1	0	0	low layer compatibility	5.4.2.3.5.12
7D		1	1	1	1	1	0	1	high layer compatibility	5.4.2.3.5.11
7F		1	1	1	1	1	1	1	Reserved	
									All other values are reserved	

Note: This Information Element may be repeated.

5.4.2.3.5.2 Bearer Capability

The purpose of the bearer capability information element is to request the provision, by the network, of the indicated ITU–T Rec. I.231 [30] bearer capability.

The bearer capability information element is coded as shown in Table 40 and Table 41.

No default bearer capability may be assumed by the absence of this information element.

Table 40
Bearer Capability Information Element

<table>
<tr><th colspan="8">Bits</th><th></th></tr>
<tr><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>Octets</th></tr>
<tr><td rowspan="3">0</td><td colspan="7">Bearer Capability</td><td rowspan="3">1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="7">Information element identifier</td></tr>
<tr><td colspan="8">Length of bearer capability information</td><td>2</td></tr>
<tr><td>1
Ext</td><td colspan="2">Coding Standard</td><td colspan="5">Information Transfer Capability</td><td>3</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">Transfer Mod</td><td colspan="5">Information Transfer Rate</td><td>4</td></tr>
<tr><td>0/1
Ext</td><td colspan="3">Structure</td><td colspan="2">Configuration</td><td colspan="2">Establishment</td><td>4a</td></tr>
<tr><td>1
Ext</td><td colspan="2">Symmetry</td><td colspan="5">Information Transfer Rate (destination origination)</td><td>4b</td></tr>
<tr><td>0/1
Ext</td><td>0
Layer 1</td><td>1
Ident.</td><td colspan="5">CE Information Layer 1 protocol</td><td>5</td></tr>
<tr><td>0/1
Ext</td><td>Synch/
Asynch</td><td>Negot</td><td colspan="5">CE Rate</td><td>5a</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">Intermediate Rate</td><td>NIC on
Tx</td><td>NIC on
Rx</td><td>0 Spare</td><td>0 Spare</td><td>0 Spare</td><td>5b</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">Number of stop bits</td><td colspan="2">Number of data bits</td><td colspan="3">Parity</td><td>5c</td></tr>
<tr><td>1
Ext</td><td>Duplex
mode</td><td colspan="6">Modem Type</td><td>5d</td></tr>
<tr><td>1
Ext</td><td>1
Layer 2</td><td>0
Ident.</td><td colspan="5">CE information Layer 2 protocol</td><td>6</td></tr>
<tr><td>1
Ext</td><td>1
Layer 3</td><td>1
Ident.</td><td colspan="5">CE information Layer 3 protocol</td><td>7</td></tr>
</table>

Table 41
Bearer Capability Information Element

Extension Bit (Octets 4, 5, 6, 7)

Bit	
8	
0	this octet continues through the next octet (e.g. 4 continues to octet 4a, or octet 4a to 4b)
1	end of current order

Coding standard (Octet 3)

Bits		
7	**6**	
0	0	ITU–T standardised
0	1	reserved
1	1	reserved

Information transfer capability (Octet 3)

Bits					
5	**4**	**3**	**2**	**1**	
0	0	0	0	0	speech
0	1	0	0	0	unrestricted digital information
0	1	0	0	1	restricted digital information
1	0	0	0	0	3.1 kHz audio

All other values are reserved.

Transfer mode (Octet 4)

Bits		
7	**6**	
0	0	circuit mode
1	0	packet mode

All other values are reserved.

Table 41 (continued)
Bearer Capability Information Element

Information transfer rate (Octet 4 and 4b, bits 5 to 1)

Bits

5	4	3	2	1	Circuit Mode
1	0	0	0	0	64 kbit/s

All other values are reserved.

Note: When octet 4b is omitted, the bearer capability is bi–directional symmetric at the information transfer rate specified in octet 4. When octet 4b is included, the information transfer rate in octet 4 refers to the origination destination direction.

Structure (Octet 4a)

Bits

7	6	5	
0	0	0	default
0	0	1	8 kHz integrity

All other values are reserved.

Note: If octet 4a is omitted, or the structure field is coded '000', then the value of the structure attribute is according to the following:

Transfer Mode	Transfer Capability	Structure
circuit	speech	8 kHz integrity
circuit	unrestricted digital	8 kHz integrity
circuit	3.1 kHz audio	8 kHz integrity
packet	unrestricted digital	service data unit integrity

Configuration (Octet 4a)

Bits

4	3	
0	0	point–to–point

All other values are reserved.

Note: If octet 4a is omitted, the configuration is assumed to be point–to–point.

Table 41 (continued)
Bearer Capability Information Element

Establishment (Octet 4a)

Bits		
2	**1**	
0	0	demand

All other values are reserved.

Note: If octet 4a is omitted, the method of establishment is assumed to be 'demand'.

Symmetry (Octet 4b)

Bits		
7	**6**	
0	0	bi–directional symmetric

All other values are reserved.

Note: If octet 4b is omitted, bi–directional symmetric is assumed.

Layer 1 protocol identification (Octet 5)

Bits		
7	**6**	**Layer Identification**
0	1	CE information layer 1 protocol

All other values are reserved.

Bits					
5	**4**	**3**	**2**	**1**	**Protocol Identification**
0	0	0	0	1	ITU–T rate adaptation [23] [24] [25] [27] [28] Octet 5a must be included
0	0	0	1	1	ITU–T Rec. G.711[22] A–law

All other values are reserved.

Synchronous/Asynchronous (Octet 5a)

Bit	
7	
0	Synchronous data
1	Asynchronous data

Table 41 (Continued)
Bearer Capability Information Element

Spare (Octet 5a)

Bit

6	
0	Spare (**shall** be set to zero)

CE Bit (Octet 5a)

Bits

5	**4**	**3**	**2**	**1**	**CE Rates** (Note 1)
0	0	0	0	0	CE rate indicated inband
0	0	0	0	1	0.6 kbit/s
0	0	0	1	0	1.2 kbit/s
0	0	0	1	1	2.4 kbit/s
0	0	1	0	0	3.6 kbit/s
0	0	1	0	1	4.8 kbit/s
0	0	1	1	0	7.2 kbit/s
0	0	1	1	1	8 kbit/s
0	1	0	0	0	9.6 kbit/s
0	1	0	0	1	14.4 kbit/s
0	1	0	1	0	16 kbit/s
0	1	0	1	1	19.2 kbit/s
0	1	1	0	0	32 kbit/s
0	1	1	1	0	48 kbit/s
0	1	1	1	1	56 kbit/s
1	0	1	0	1	0.1345 kbit/s
1	0	1	1	0	0.100 kbit/s
1	0	1	1	1	0.075/1.200 kbit/s (Tx/Rx) (Note 2)
1	1	0	0	0	1.200/0.075 kbit/s (Tx/Rx) (Note 2)
1	1	0	0	1	0.050 kbit/s
1	1	0	1	0	0.075 kbit/s
1	1	0	1	1	0.110 kbit/s
1	1	1	0	0	0.150 kbit/s
1	1	1	0	1	0.200 kbit/s
1	1	1	1	0	0.300 kbit/s
1	1	1	1	1	12 kbit/s

All other values are reserved.

Table 41 (continued)

Bearer Capability Information Element

Note 1: Some CE rates may not be supported by some network resources.

Note 2: 'ITU–T Recs. V.6 [57] and X.1 [65].' The first rate is the transmit rate in the forward direction of the call. The second rate is the transmit rate in the backward direction of the call.

Intermediate Rate (Octet 5b)

Bits		
7	**6**	
0	0	not used
0	1	8 kbit/s
1	0	16 kbit/s
1	1	32 kbit/s

Network Independent Clock on Transmission (NIC on Tx) (Octet 5b)

Bits	
5	
0	Does not require to send data with NIC
1	Requires to send data with NIC

Note: Refer to ITU–T Recs. V.110 [63] and X.30 [68].

Network Independent Clock on Reception (NIC on Rx) (Octet 5b)

Bits	
4	
0	Cannot accept data with NIC
1	Can accept data with NIC

Note 1: Refer to ITU–T Recs. V.110 [63] and X.30 [68]

Note 2: The codes in bits 4, 5 of octet 5b are significant only when octet 5a, bit 7 indicates synchronous, otherwise they **shall** be ignored.

Spare (Octet 5b)

Bits			
3	**2**	**1**	
0	0	0	Spare (**shall** be set to zero)

Table 41 (continued)

Bearer Capability Information Element

Number of Stop Bits (Octet 5c) **Note 1**

Bits		
7	**6**	
0	0	Note 2
0	1	1 bit
1	0	1.5 bits
1	1	2 bits

Note 1: Not all values are supported by some network resources.

Note 2: Only used when synchronous data indicated.

Number of Data Bits (Octet 5c) **Note 1**

Bits		
5	**4**	
0	0	Note 2
0	1	5 bits
1	0	7 bits
1	1	8 bits

Note 1: The number of data bits includes the parity bit if present. All values are not supported by some network resources.

Note 2: Only used when synchronous data indicated.

Parity (Octet 5c)

Bits			
3	**2**	**1**	
0	0	0	Odd
0	1	0	Even
0	1	1	None. See Note
1	0	0	Forced to 0
1	0	1	Forced to 1

All other values are reserved.

Note: Used when synchronous data indicated, or no parity associated with asynchronous data.

Table 41 (continued)

Bearer Capability Information Element

Duplex type (Octet 5d)

Bit	
7	
0	Half duplex
1	Full duplex

Modem type (Octet 5d)

Bits

6	**5**	**4**	**3**	**2**	**1**	
0	0	0	0	0	0	undefined
0	0	0	0	0	1	V.23 [61]
0	0	0	0	1	0	V.22 bis [60]
0	0	0	0	1	1	V.32 [62]
0	0	0	1	0	0	V.21 [58]
0	0	0	1	0	1	V.22 [59]

All other values reserved.

Note: Further code points may be defined for manufacturer–specific modems. The 'Undefined' code point is used when it is only required to define the Duplex Mode.

Layer 2 Identification Bits (Octet 6)

Bits

7	**6**	
1	0	Layer 2 Identification

CE Information Layer 2 Protocol (Octet 6)

Bits

5	**4**	**3**	**2**	**1**	
0	0	0	1	0	I.441 [37]
0	0	1	1	0	X.25 [67]

All other values reserved.

Note: If the transfer mode is 'packet mode', then octet 6 **shall** be present. For other cases, the CE layer 2 protocol is to be identified to the network, then octet 6 **shall** be present; otherwise octet 6 **shall** be omitted.

Table 41 (continued)

Bearer Capability Information Element

Layer 3 Identification Bits (Octet 7)

Bits		
7	**6**	
1	1	Layer 3 Identification

CE Information Layer 3 Protocol (Octet 7)

Bits					
5	**4**	**3**	**2**	**1**	
0	0	0	1	0	I.451 [39]
0	0	1	1	0	X.25 [67]

All other values reserved.

Note: If the CE information layer 3 protocol is to be identified to the network, octet 7 **shall** be present; otherwise octet 7 **shall** be omitted.

5.4.2.3.5.3 Call State

The purpose of the call state information element is to describe the current status of a call. The call state information element is coded as shown in Table 42 and Table 43.

Table 42
Call State Information Element

8	7	6	5	4	3	2	1	Octet
Call state Information element identifier								
0	0	0	1	0	1	0	0	1
Length of call state contents								2
Coding Standard		Call state value/global interface state value (stated value is coded in binary)						3

Table 43
Call State Information Element

Coding Standard (Octet 3)

Bits

8	7	
0	0	ITU–T Standardised Coding

Call State Value (Octet 3)

Bits

6	5	4	3	2	1	CE State	Network State
0	0	0	0	0	0	**U0** – Null	**N0** – Null
0	0	0	0	0	1	**U1** – Call initiated	**N1** – Call initiated
0	0	0	0	1	0	**U2** – Overlap sending	**N2** – Overlap sending
0	0	0	0	1	1	**U3** – Out going call proceeding	**N3** – Out going call proceeding
0	0	0	1	0	0	**U4** – Call delivered	**N4** – Call delivered
0	0	0	1	1	0	**U6** – Call present	**N6** – Call present
0	0	0	1	1	1	**U7** – Call received	**N7** – Call received
0	0	1	0	0	0	**U8** – Connect request	**N8** – Connect request
0	0	1	0	0	1	**U9** – Incoming call proceeding	**N9** – Incoming call proceeding
0	0	1	0	1	0	**U10** – Active	**N10** – Active
0	0	1	0	1	1	**U11** – Disconnect request	**N11** – Disconnect request
0	0	1	1	0	0	**U12** – Disconnect indication	**N12** – Disconnect indication
0	1	0	0	1	1	**U19** – Release request	**N19** – Release request
0	1	1	0	0	1	---------- --------	**N25** – Overlap Receiving

All other values are reserved.

5.4.2.3.5.4 Called Party Number

The purpose of the information element is to identify one called party of a call. The called party number information element is coded as shown in Table 44 and Table 45.

Table 44
Called Party Number Information Element

Bits 8	7	6	5	4	3	2	1	Octet
Called party number								
0	1	1	1	0	0	0	0	1
Information element identifier								
Length of called party number contents								2
1 Ext	Type of number			Numbering plan identification				3
0	Number digits A (IA5 characters) Note							4

Note: The number digits appear in multiple Octet 4's in the same order in which they would be entered, that is, the number digit which would be entered first is located in first Octet 4.

Table 45
Called Party Number Information Element

Type of number (Octet 3) (Note 1)

Bits

7	6	5	
0	0	0	Unknown (Note 2)
0	0	1	International number (Note 3)
0	1	0	National number
1	0	0	Local (directory) number

All other values reserved.

Note 1: For the definition of 'number', see ITU–T Rec. I.330 [32].

Note 2: If type of number 'unknown' is used the number information will include all called party number information (i.e. including all prefixes).

Note 3: If type of number 'international' is used the number information will not include the international access code.

Numbering plan identification (Octet 3)

Bits

4	3	2	1	
0	0	0	1	ISDN numbering plan (ITU–T Rec. E.164 [17])
0	0	1	1	Data numbering plan (ITU–T Rec. X.121 [71])

All other values are reserved.

Number Digits (Octet 4, etc.)

Bits							
7	**6**	**5**	**4**	**3**	**2**	**1**	**Digit Value**
0	1	1	0	0	0	0	0
0	1	1	0	0	0	1	1
0	1	1	0	0	1	0	2
0	1	1	0	0	1	1	3
0	1	1	0	1	0	0	4
0	1	1	0	1	0	1	5
0	1	1	0	1	1	0	6
0	1	1	0	1	1	1	7
0	1	1	1	0	0	0	8
0	1	1	1	0	0	1	9

In accordance with ITU–T Rec. E.164 [17] and I.330 [32], only the decimal digits 0–9 **shall** be interpreted by the network as number information.

5.4.2.3.5.5 Called Party Subaddress

The purpose of the called party subaddress information element is to convey to the called party the called party subaddress. The network does not interpret this information.

The called party subaddress information element is coded as shown in Table 46 and Table 47. The maximum length of this information element is 23 octets.

Table 46
Called Party Subaddress Information Element

8	7	6	5	4	3	2	1	Octet
Called Party Subaddress 0 1 1 1 0 0 0 1 Information element identifier								1
Length of called party subaddress contents								2
1 Ext	Type of Subaddress			Odd/ Even	0	0 Spare	1	3
Subaddress Information								4 etc.

Table 47
Called Party Subaddress Information Element

Type of Subaddress (Octet 3)

Bits

7	6	5	Meaning
0	0	0	NSAP (ITU–T Rec. X.213 [73] / ISO 8348 AD2) [13]
0	1	0	CE specified

All other values reserved.

Odd/Even indicator (Octet 3)

Bit

4	
0	even number of address signals
1	odd number of address signal

Note: The odd/even indicator is used when the type of subaddress is 'CE specified' and the coding is BCD.

Subaddress information (Octet 4, etc)

The NSAP ITU–T Rec. X.213 [73]/ISO 8348 [13] AD2 address **shall** be formatted as specified by octet 4 which contains the Authority and Format Identifier (AFI). The encoding is made according to the 'preferred binary encoding' as defined in NSAP ITU–T Rec. X.213 [73]/ISO 8348 [13] AD2.

For CE specified subaddress, this field is encoded according to the CE specification, subject to a maximum length of 20 octets. When interworking with ITU–T Rec. X.25 [67] networks BCD coding should be applied.

Note: It is recommended that CEs apply the NSAP subaddress type since this subaddress type allows the use of decimal, binary and IA5 characters in a standardised manner.

5.4.2.3.5.6 Calling Party Number

The purpose of the calling party number information element is to identify the origin of a call.

The calling party number information element is coded as shown in Table 48 and Table 49.

Table 48
Calling Party Number Information Element

<table>
<tr><td colspan="8">Bits</td><td></td></tr>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>Octet</td></tr>
<tr><td colspan="8">Called party number</td><td rowspan="3">1</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">Information element identifier</td></tr>
<tr><td colspan="8">Length of calling party information</td><td>2</td></tr>
<tr><td>0/1
Ext</td><td colspan="3">Type of number</td><td colspan="4">Numbering plan identification</td><td>3
Note 1</td></tr>
<tr><td>1
Ext</td><td colspan="2">Presentation indicator</td><td>0
Spare</td><td>0</td><td>0</td><td colspan="2" rowspan="2">Screening Indicator</td><td rowspan="2">3a
Note 2</td></tr>
<tr><td></td><td colspan="2"></td><td></td><td colspan="2">Reserved</td></tr>
<tr><td>0
Spare</td><td colspan="7">Number digits (IA5 characters). Note 1</td><td>4 etc.</td></tr>
</table>

Note 1: The contents of this Octet is coded as shown in Table 45.

Note 2: This octet may be omitted.

Table 49
Calling Party Number Information Element

Presentation indicator (Octet 3a) (Note)

Bits

7	**6**	**Meaning**
0	0	Presentation allowed
0	1	Presentation restricted
1	0	Number not available due to interworking
1	1	Reserved

Note: If octet 3a is omitted '0 0 – Presentation allowed' is assumed.

Screening indicator (Octet 3a)

Bits

2	**1**	**Meaning**
0	0	Reserved
0	1	CE provided, verified and passed
1	0	Reserved
1	1	Network provided

Note: If octet 3a is omitted, '0 1 – CE provided verified and passed' is assumed.

Number Digits (Octet 4, etc.)

Bits

7	**6**	**5**	**4**	**3**	**2**	**1**	**Digit Value**
0	1	1	0	0	0	0	0
0	1	1	0	0	0	1	1
0	1	1	0	0	1	0	2
0	1	1	0	0	1	1	3
0	1	1	0	1	0	0	4
0	1	1	0	1	0	1	5
0	1	1	0	1	1	0	6
0	1	1	0	1	1	1	7
0	1	1	1	0	0	0	8
0	1	1	1	0	0	1	9

In accordance with ITU–T Recs. E.164 [17] and I.330 [32], only the decimal digits 0–9 **shall** be interpreted by the network as number information.

5.4.2.3.5.7 Calling Party Subaddress

The purpose of the calling party subaddress information element is to convey calling subaddress information to the called party. The network does not interpret this information.

The calling party subaddress information element is coded as shown in Table 50 and Table 51.

Table 50
Calling Party Subaddress Information Element

<table>
<tr><td colspan="8">Bits</td><td></td></tr>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>Octet</td></tr>
<tr><td colspan="8">Called Party Subaddress
0 1 1 0 1 1 0 1
Information element identifier</td><td>1</td></tr>
<tr><td colspan="8">Length of calling party subaddress contents</td><td>2</td></tr>
<tr><td>1
Ext</td><td colspan="3">Type of Subaddress</td><td>Odd/
Even
Indicator</td><td colspan="3">0 0 0
Spare</td><td>3</td></tr>
<tr><td colspan="8">Subaddress Information</td><td>4 etc.</td></tr>
</table>

Table 51
Calling Party Subaddress Information Element

Type of Subaddress (Octet 3)

Bits

7	6	5	Meaning
0	0	0	NSAP (ITU–T Rec. X.213 [73]/ISO 8348 [13] AD2)
0	1	0	CE specified

All other values reserved.

Odd/Even indicator (Octet 3)

Bit

4	
0	even number of address signals
1	odd number of address signals

Note: The odd/even indicator is used when the type of subaddress is 'CE specified' and the coding is BCD.

Subaddress information (Octet 4, etc.)

The NSAP ITU–T Rec. X.213 [73]/ISO 8348 [13] AD2 address **shall** be formatted as specified by octet 4 which contains the Authority and Format Identifier (AFI). The encoding is made according to the 'preferred binary encoding' as defined in NSAP ITU–T Rec. X.213 [73]/ISO 8348 [13] AD2.

For CE specified subaddress, this field is encoded according to the CE specification, subject to a maximum length of 20 octets. When interworking with ITU–T Rec. X.25 [67] networks BCD coding should be applied.

Note: It is recommended that CEs apply the NSAP subaddress type since this subaddress type allows the use of decimal, binary and IA5 characters in a standardised manner.

5.4.2.3.5.8 Cause

The purpose of the cause information element is to describe the reason for generating certain messages, to provide diagnostic information in the event of procedural errors and to indicate the location of the cause originator.

The cause information element is coded as shown in Table 52 and Table 53. Diagnostic information is not available for every cause. When available the coding of the diagnostic(s) is the same as for the corresponding information element identifier facility identifier or message type code. The cause information element may be repeated in a message, e.g. to report multiple errors associated with a single call. Definitions of the causes are provided in Appendix B.

Table 52
Cause Information Element

Bits 8	7	6	5	4	3	2	1	Octet
0	Cause 1	1	0	1	1	0	1	1
	Information element identifier							
Length of Cause Contents								2
1 Ext	Coding Standard		0 Spare	Location				3
1 Ext	Cause value							4
Diagnostic(s) (if any)								5 Note

Note: This octet may be omitted when no diagnostic is required. If a diagnostic is listed in Table 53 for the cause, this octet **shall** include that diagnostic. This octet group may be more than 1 octet long.

Table 53
Cause Information Element

Coding standard (Octet 3)

Bits

7	6	
0	0	ITU–T standard

All other values reserved.

Location (Octet 3)

Bits

4	3	2	1	
0	0	0	0	CE
0	0	0	1	Local private network, e.g. PABX
0	0	1	0	Local exchange
0	1	0	0	Remote exchange

All other values are reserved.

Note: Depending on the location of the CEs, the local exchange and remote exchange may be the same exchange.

Cause value (Octet 4)

The cause value is divided in two fields, a class (bits 5 through 7) and a value within the class (bits 1 through 4).

The class indicates the general nature of the event.

Class (0 0 0)	:	Normal event
Class (0 0 1)	:	Resources unavailable
Class (0 1 0)	:	Service or option not available
Class (0 1 1)	:	Service or option not implemented
Class (1 0 0)	:	Invalid message (e.g. parameter out of range)
Class (1 1 0)	:	Protocol error (e.g. unknown message)
Class (1 1 1)	:	Interworking

Diagnostics (Octet 5)

Diagnostic information is not available for every cause. The inclusion of diagnostics is optional. When available the coding of diagnostic(s) is the same for the corresponding information element defined in Clause 5.4.2.3.

Table 53 (continued)
Cause Information Element

Cause Value (Octet 4)									
Class			Value				Cause Number	Cause	Diagnostics
7	6	5	4	3	2	1			
0	0	0	0	0	0	1	1	Unassigned (unallocated) number	
0	0	0	0	1	1	0	6	Channel unacceptable	
0	0	1	0	0	0	0	16	Normal clearing	
0	0	1	0	0	0	1	17	User busy	
0	0	1	0	0	1	0	18	No user responding	
0	0	1	0	1	0	1	21	Call rejected	
0	0	1	0	1	1	0	22	Number changed	
0	0	1	1	0	1	1	27	Destination out of service	
0	0	1	1	1	0	0	28	Invalid number format	
0	0	1	1	1	1	0	30	Response to STATUS ENQUIRY	
0	0	1	1	1	1	1	31	Normal, unspecified	
0	1	0	0	0	1	0	34	No circuit/channel available	
0	1	0	0	1	1	0	38	Network out of order	
0	1	0	1	0	0	1	41	Temporary failure	
0	1	0	1	0	1	0	42	Switching equipment congestion	
0	1	0	1	1	0	0	44	Requested circuit channel not available	
0	1	0	1	1	1	1	47	Resource unavailable unspecified	
0	1	0	1	0	0	1	57	Bearer capability not authorised	
0	1	1	1	0	1	0	58	Bearer capability not presently available.	

Table 53 (Continued)
Cause Information Element

Cause Value (Octet 4)									
Class			Value				Cause Number	Cause	Diagnostics
7	**6**	**5**	**4**	**3**	**2**	**1**			
0	1	1	1	1	1	1	63	Service or option not available, unspecified	
1	0	0	0	0	0	1	65	Bearer capability not implemented	
1	0	0	0	0	1	0	66	Channel type not implemented	
1	0	0	0	1	1	0	70	Only restricted digital information bearer capability is available	
1	0	0	1	1	1	1	79	Service or option not implemented, unspecified	
1	0	1	0	0	0	1	81	Invalid call reference value	
1	0	1	0	0	1	1	82	Identified channel does not exist	
1	0	1	1	0	0	0	88	Incompatible destination	Bearer capability identifier, or Low Layer compatibility identifier or Higher Layer compatibility identifier
1	0	1	1	1	1	1	95	Invalid message, unspecified	
1	1	0	0	0	0	0	96	Mandatory information element is missing	Information element identifier
1	1	0	0	0	0	1	97	Message type non–existent or not implemented	Message type
1	1	0	0	0	1	0	98	Message not compatible with call state, non–existent or not implemented	Message type
1	1	0	0	0	1	1	99	Information element non–existent or not implemented	Information element identifier
1	1	0	0	1	0	0	100	Invalid information element contents	Information element identifier
1	1	0	0	1	0	1	101	Message not compatible with call state	Message type
1	1	0	0	1	1	0	102	Recovery on timer expiry	
1	1	0	1	1	1	1	111	Protocol error, unspecified	
1	1	1	1	1	1	1	127	Interworking, unspecified	

All other values are reserved.

5.4.2.3.5.9 Channel Identification

The purpose of the channel identification information element is to identify a channel within the interface controlled by these signalling procedures.

The channel identification information element is coded as shown in Table 54 and Table 55.

Table 54
Channel Identification Information Element

Bits 8	7	6	5	4	3	2	1	Octet
0	0 Channel identification Information element identifier	0	1	1	0	0	0	1
Length of channel identification								2
1 Ext Note 2	Int. Id Present	Int. type	0 Spare	Pref/ Excl	D–Ch Ind	B–Channel selection		3
1 Ext Note 2	Coding Standard		Number	Channel type				4 Note 1
0	Channel Number							5 Note 1

Note 1: Octet 4 and 5 may be omitted.

Note 2: This bit is reserved for extension of this octet.

Table 55
Channel Identification Information Element

Interface identifier present (Octet 3)

Bit

7

0 the interface which includes the D–Channel carrying this information element is indicated

1 reserved

Table 55 (Continued)

Cause Information Element

Interface type (Octet 3)

Bit	
6	
0	Reserved
1	Primary rate interface

Spare (Octet 3)

Bit	
5	
0	Spare

Preferred/Exclusive (Octet 3)

Bit	
4	
0	indicated channel is preferred
1	exclusive; only the indicated channel is acceptable

Note: This bit has only significance in relation to B–Channel selection.

D–Channel indicator (Octet 3)

Bit	
3	
0	the channel identified is not the D–Channel
1	the channel identified is the D–Channel

B-Channel selection (Octet 3)

Bits		
2	**1**	
0	0	No channel
0	1	Channel as indicated in following octets
1	0	Reserved
1	1	Any channel

Table 55 (Continued)

Cause Information Element

Coding standard (Octet 4)

Bits

7	6	
0	0	ITU–T standard

All other values are reserved.

Number (Octet 4)

Bit

5	
0	Channel is indicated by the number in the following octet
1	Reserved

Channel type (Octet 4)

Bits

4	3	2	1	
0	0	1	1	B–Channel units

All other values are reserved.

Channel number (Octet 5)

Binary number assigned to the channel.

Note: Bit 8 is reserved for extension and **shall** be set to '0'. Channels are assigned to time–slots as defined in Clause 5.2 of this Technical Standard.

Example: Channel identification information element, primary rate, number 12
B–Channel preferred.

Table 56
Channel Identification Information Element (example)

Bits 8	7	6	5	4	3	2	1	Octet
Channel identification 0	0	0	1	1	0	0	0	1
0	0	0	0	0	0	1	1 Length	2
1 Ext	0 Int Id	1 Int Type	0 Spare	0 Pref	0 D–ch Id	0 B–Channel	1	3
1 Ext	0 ITU–T Std	0	0 No	0 B–Channel	0	1	1	4
0	0 Channel Number 12	0	0	1	1	0	0	5

5.4.2.3.5.10 **Display**

The purpose of the display information element is to supply information for display purposes. The information contained in this element is coded in IA5 characters.

Table 57
Display Information Element

Bits 8	7	6	5	4	3	2	1	Octet
0	Display 0	1	0	1	0	0	0 Information element identifier	1
Length of display information								2
0	Display information (IA5 characters)							3 etc.

5.4.2.3.5.11 **High Layer Compatibility**

The purpose of the high layer compatibility information element is to provide a means which should be used by the remote CE for compatibility checking.

The high layer compatibility information element is coded as shown in Table 58 and Table 59.

Note: The high layer compatibility information element is transported transparently by the network between a call originating entity, e.g. a calling CE, and the addressed entity, e.g. a remote CE or a high layer function network node addressed by the call originating entity.

Table 58
High Layer Compatibility Information Element

<table>
<tr><td colspan="8">Bits</td><td></td></tr>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>Octet</td></tr>
<tr><td></td><td colspan="7">High layer compatibility</td><td></td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td></td><td colspan="7">Information element identifier</td><td></td></tr>
<tr><td colspan="8">Length of compatibility information</td><td>2</td></tr>
<tr><td>1
Ext</td><td colspan="7"></td><td></td></tr>
<tr><td>1
Ext
Note</td><td colspan="7">High layer characteristics identification</td><td>4</td></tr>
</table>

Note: Reserved for future extension.

Table 59
High Layer Compatibility Information Element

Coding Standard (Octet 3)

Bits

7 6

0 0 ITU–T standard coding

All other values reserved.

Interpretation (Octet 3)

Bits

5 4 3

1 0 0 First (primary or only) high layer characteristic (in octet 4)to be used in the call

All other values reserved.

Presentation (Octet 3)

Bits

2 1

0 1 High layer protocol profile (without specific specification of attributes)

All other values are reserved.

High Layer Characteristic Identification (Octet 4) Note

Bits

	7	6	5	4	3	2	1	ITU–T Standard
01	0	0	0	0	0	0	1	Telephony (ITU–T Rec. G.711 [22])
04	0	0	0	0	1	0	0	Gp. 2/3 facsimile (ITU–T Rec. F.182 [18])
41	0	1	0	0	0	0	1	Document Application Profile for Group 4 Class 1 facsimile (ITU–T Rec. T.503 [55])
44	0	1	0	0	1	0	0	Document Application Profile for formatted Mixed Mode (ITU–T Rec. T.501 [53])
48	0	1	0	1	0	0	0	Document Application Profile for Processable Form (ITU–T Rec. T.502 [54])
61	0	1	1	0	0	0	1	Teletext (ITU–T Recs. T.62 [50], T.70 [51])
62	0	1	1	0	0	1	0	Document Application Profile for Videotex Interworking between Gateways (ITU–T Rec. T.504 [56])
65	0	1	1	0	1	0	1	Telex
70	0	1	1	1	0	0	0	Message Handling Systems (MHS) (Rec. X.400 [75] series)
81	1	0	0	0	0	0	1	OSI applications (Note) (ITU–T Rec. X.200 [72] series)

All other values are reserved.

Note: Further compatibility checking will be executed by the OSI high layer protocols.

5.4.2.3.5.12 Low Layer Compatibility

The purpose of the low layer compatibility information element is to provide a means which should be used for compatibility checking by an addressed entity (e.g. a remote CE or an interworking unit or a high layer function network node addressed by the calling CE). The low layer compatibility information element is transferred transparently by the network between the call originating entity (e.g. the calling CE) and the addressed entity.

The low layer compatibility information element is coded as shown in Table 60 and Table 61.

Note: There are 16 octets defined for this information element. However, the ability to not accept more than 13 octets is network dependent.

Table 60
Lower Layer Compatibility Information Element

<table>
<tr><th colspan="8">Bits</th><th></th></tr>
<tr><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>Octet</th></tr>
<tr><td>0</td><td colspan="7">High layer compatibility
1 1 1 1 1 0 0
Information element identifier</td><td>1</td></tr>
<tr><td colspan="8">Length of lower layer compatibility contents</td><td>2</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">Coding Standard</td><td colspan="5">Information transfer capability</td><td>3</td></tr>
<tr><td>1
Ext</td><td>Negot.
Indic</td><td colspan="6">0 0 0 0 0 0
Spare</td><td>3a</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">Transfer mode</td><td colspan="5">Information transfer rate</td><td>4</td></tr>
<tr><td>0/1
Ext</td><td colspan="3">Structure</td><td colspan="2">Configuration</td><td colspan="2">Establishment</td><td>4a
Note 1</td></tr>
<tr><td>1
Ext</td><td colspan="2">Symmetry</td><td colspan="5">Information transfer rate (destination origin)</td><td>4b</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">0 1
Layer 1 Ident.</td><td colspan="5">CE information layer 1 protocol</td><td>5</td></tr>
<tr><td>0/1
Ext</td><td>Synch
Asynch</td><td>Negot</td><td colspan="5">CE rate</td><td>5a
Note 4</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">Intermediate rate</td><td>NIC on
Tx</td><td>NIC on
Rx</td><td>Flow control on TX</td><td>Flow control on RX</td><td>0
Spare</td><td>5b
Note 2</td></tr>
<tr><td>0/1
Ext</td><td>Hdr/
No Hdr</td><td>Multi-frame Support</td><td>Mode</td><td>LLI
Negot.</td><td>Assignor
/assignee</td><td>In-band/
out-band negot.</td><td>0
Spare</td><td>5b
Note 3</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">Number of stop bits</td><td colspan="2">Number of data bits</td><td colspan="3">Parity</td><td>5c
Note 4</td></tr>
<tr><td>1
Ext</td><td>Duplex mode</td><td colspan="6">Modem type</td><td>5d
Note 4</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">1 0
Layer 2 Ident.</td><td colspan="5">CE information layer 2 protocol</td><td>6</td></tr>
<tr><td>1
Ext</td><td colspan="7">Optional layer 2 protocol information</td><td>6a</td></tr>
<tr><td>0/1
Ext</td><td colspan="2">1 1
Layer 3 Ident.</td><td colspan="5">CE information layer 3 protocol</td><td>7</td></tr>
<tr><td>1
Ext</td><td colspan="7">Optional layer 3 protocol information</td><td>7a</td></tr>
</table>

Notes to Table 60

Note 1: If default values are used for all fields of octets 4a and 4b, then these octets **shall not** be included. If default values are used for all fields of octets 4b, but not for one or more fields of octets 4a, then only octet 4a **shall** be included. Otherwise, both octets 4a and 4b **shall** be included.

Note 2: This octet may be present only if octet 5 indicates ITU–T standardised rate adaptation Rec. V.110 [63]/Rec. X.30 [68].

Note 3: This octet present only if octet 5 indicates ITU–T standardised rate adaptation V.120 [64].

Note 4: This octet may be present if octet 5 indicates either of the ITU–T standardised rate adaptation Rec. V.110 [63]/Rec. X.30 [68] or Rec. V.120 [64].

Table 61
Low Layer Compatibility Information Element

Coding Standard (Octet 3)

Bits		
7	**6**	
0	0	ITU–T standardised coding

All other values are reserved.

Note: These other coding standards should be used only when the desired low layer compatibility can not be represented with the ITU–T standardised coding.

Information transfer capability (Octet 3)

Bits					
5	**4**	**3**	**2**	**1**	
0	0	0	0	0	Speech
0	1	0	0	0	Unrestricted digital information
0	1	0	0	1	Restricted digital information
1	0	0	0	0	3.1 kHz audio
1	0	0	0	1	7 kHz audio

All other values are reserved.

Table 61
Low Layer Compatibility Information Element (cont.)

Negotiation indicator (Octet 3a)

Bit	
7	
0	Out–band negotiation not possible

All other values are reserved.

Note: When octet 3a is omitted, 'out–band negotiation not possible' **shall** be assumed.

Transfer mode (Octet 4)

Bits

7	**6**	
0	0	circuit mode
1	0	packet–mode

All other values are reserved.

Information transfer rate (Octets 4 and 4b)

Bits

5	**4**	**3**	**2**	**1**	Circuit mode	Packet mode
0	0	0	0	0	–	This code **shall** be used for packet mode calls
1	0	0	0	0	64 kbit/s	

All other values are reserved.

Note: When octet 4b is omitted, the low layer compatibility is bi–directional symmetric at the information transfer rate specified in octet 4. When octet 4b is included, the information transfer rate in octet 4 refers to the origination to destination direction.

Structure (Octet 4a)

Bits

7	**6**	**5**	
0	0	0	default (Note)
0	0	1	8 kHz integrity
1	0	0	service data unit integrity

All other values are reserved.

Note: If octet 4a is omitted, or the structure field is coded '000', then the value of the structure attribute is according to the following:

Transfer Mode	Transfer capability	Structure
Circuit	Speech	8 kHz integrity
Circuit	Unrestricted digital	8 kHz integrity
Circuit	Restricted digital	8 kHz integrity
Circuit	3.1 kHz audio	8 kHz integrity
Packet	Unrestricted digital	Service data unit integrity

Configuration (Octet 4a)

Bits

4	**3**	
0	0	point–to–point

All other values are reserved.

Note: If octet 4a is omitted, the configuration is assumed to be point–to–point.

Establishment (Octet 4a)

Bits

2 1

0 0 demand

All other values are reserved.

Note: If octet 4a is omitted, the method of establishment is assumed to be 'demand'.

Symmetry (Octet 4b)

Bits

7 6

0 0 bi–directional symmetric

All other values are reserved.

Note: If octet 4b is omitted, bi–directional symmetric is assumed.

Table 61
Low Layer Compatibility Information Element (cont.)

CE information layer 1 protocol (Octet 5)

The coding below applies in the case of 'Coding Standard' = 'ITU–T Standard'.

Bits 5	4	3	2	1	
0	0	0	0	0	ITU–T standardised rate adaptation Rec. V.110 [63]/Rec. X.30 [68]. This implies the presence of octet 5a and optionally octets 5b, 5c and 5d as defined below.
0	0	0	1	0	ITU–T Rec. G.711 [22] μ–law
0	0	0	1	1	ITU–T Rec. G.711 [22] A–law
0	0	1	0	0	ITU–T Rec. G.721 [23] 32 kbit/s ADPCM and ITU–T Rec. I.460 [40]
0	0	1	0	1	ITU–T Recs. G.722 [24] and G.725 [25] 7 kHz audio
0	0	1	1	0	ITU–T Rec. H.261 [29] for 384 kbit/s video
0	0	1	1	1	Non–ITU–T standardised rate adaptation. This implies the presence of octet 5a and, optionally, octets 5b, 5c and 5d. The use of this code point indicates that the CE rate specified in octet 5a is defined by the CE. Additionally octets 5b, 5c and 5d, if present, are defined consistent with the CE specified rate adaptation.
0	1	0	0	0	ITU–T standardised rate adaptation Rec. V.120 [64]. This implies the presence of octets 5a and 5b as defined below, and optionally octets 5c and 5d.
0	1	0	0	1	ITU–T standardised rate adaptation Rec. X.31 [69] HDLC flag stuffing.

All other values are reserved.

Note: If the transfer mode is 'circuit mode', and if the information transfer capability is 'unrestricted digital information' or 'restricted digital information', and if the CE information layer 1 protocol is not to be identified to the network, octet 5 **shall** be omitted. If the transfer mode is packet mode, octet 5 may be omitted. Otherwise, octet 5 **shall** be present.

Table 61
Low Layer Compatibility Information Element (cont.)

Synchronous/asynchronous (5a)

Bit 7	
0	Synchronous
1	Asynchronous

Note: Octets 5b–5d may be omitted in case of synchronous CE rates.

Negotiation (Octet 5a)

Bit

6	
0	In–band negotiation not possible
1	In–band negotiation possible

Note: See ITU–T Recs. V.110 [63] and X.30 [68].

CE rate (Octet 5a)

Bits

5	**4**	**3**	**2**	**1**	
0	0	0	0	0	Rate is indicated by E–bits specified in ITU–T Rec. I.460 [40]
0	0	0	0	1	0.6 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
0	0	0	1	0	1.2 kbit/s ITU–T Rec. V.6 [57]
0	0	0	1	1	2.4 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
0	0	1	0	0	3.6 kbit/s ITU–T Rec. V.6 [57]
0	0	1	0	1	4.8 kbit/s ITU–T Recs. V.6 [57]and X.1 [65]
0	0	1	1	0	7.2 kbit/s ITU–T Rec. V.6 [57]
0	0	1	1	1	8 kbit/s ITU–T Rec. I.460 [40]
0	1	0	0	0	9.6 kbit/s ITU–T Rec. V.6 [57] and X.1 [65]
0	1	0	0	1	14.4 kbit/s ITU–T Rec. V.6 [57]
0	1	0	1	0	16 kbit/s ITU–T Rec. I.460 [40]
0	1	0	1	1	19.2 kbit/s ITU–T Rec. V.6 [57]

Table 61
Low Layer Compatibility Information Element (cont.)

CE rate (Octet 5a) continued

Bits

5	**4**	**3**	**2**	**1**	
0	1	1	0	0	32 kbit/s ITU–T Rec. I.460 [40]
0	1	1	1	0	48 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
0	1	1	1	1	56 kbit/s ITU–T Rec. V.6 [57]
1	0	1	0	1	0.1345 kbit/s ITU–T Rec. X.1 [65]
1	0	1	1	0	0.100 kbit/s ITU–T Rec. X.1 [65]
1	0	1	1	1	0.075/1.2 kbit/s ITU–T Recs. V.6 [57] and X.1 [65] (Note)
1	1	0	0	0	1.2/0.075 kbit/s ITU–T Recs. V.6 [57] and X.1 [65] (Note)
1	1	0	0	1	0.050 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
1	1	0	1	0	0.075 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
1	1	0	1	1	0.110 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
1	1	1	0	0	0.150 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
1	1	1	0	1	0.200 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
1	1	1	1	0	0.300 kbit/s ITU–T Recs. V.6 [57] and X.1 [65]
1	1	1	1	1	12 kbit/s ITU–T Rec. V.6 [57]

All other values are reserved.

Note: The first rate is the transmit rate in the forward direction of the call. The second rate is the transmit rate in the backward direction of the call.

Octet 5b for ITU–T Recs. V.110 [63]/X.30 [68] rate adaptation

Intermediate Rate (Octet 5b)

Bits

7	**6**	
0	0	Not used
0	1	8 kbit/s
1	0	16 kbit/s
1	1	32 kbit/s

Table 61
Low Layer Compatibility Information Element (cont.)

Network Independent Clock (NIC) on Transmission (Tx) (Octet 5b) (Note 1)

Bit

5

0 Not required to send data with Network Independent Clock

1 Required to send data with Network Independent Clock

Note 1: Refers to transmission in the forward direction of the call.

Note 2: See ITU–T Recs. V.110 [63] and X.30 [68].

Network Independent Clock (NIC) on Reception (Rx) (Octet 5b) (Note 1)

Bit

4

0 Cannot accept data with Network Independent Clock (i.e. sender does not support this optional procedure)

1 Can accept data with Network Independent Clock (i.e. sender does support this optional procedure)

Note 1: Refers to transmission in the backward direction of the call.

Note 2: See ITU–T Recs. V.110 [63] and X.30 [68].

Flow Control on Transmission (Tx) (Octet 5b) (Note 1)

Bit

3

0 Not required to send data with flow control mechanism

1 Required to send data with flow control mechanism

Note 1: Refers to transmission in the forward direction of the call.

Note 2: See ITU–T Recs. V.110 [63] and X.30 [68].

Table 61
Low Layer Compatibility Information Element (cont.)

Flow Control on Reception (Rx) (Octet 5b) (Note 1)

Bit
2

0	Cannot accept data with flow control mechanism (i.e. sender does not support this optional procedure)
1	Can accept data with flow control mechanism (i.e. sender does support this optional procedure)

Note 1: Refers to transmission in the backward direction of the call.

Note 2: See ITU–T Recs. V.110 [63] and X.30 [68].

Octet 5b for ITU–T Rec. V.120 [64] rate adaptation

Rate adaptation header/no header (Octet 5b)

Bit
7

0	rate adaptation header not included
1	rate adaptation header included

Multiple Frame establishment support in Data Link (Octet 5b)

Bit
6

0	Multiple Frame establishment not supported. Only UI frames allowed
1	Multiple Frame establishment supported

Mode of Operation (Octet 5b)

Bit
5

0	Bit transparent mode of operation
1	Protocol sensitive mode operation

Table 61
Low Layer Compatibility Information Element (cont.)

Logical Link Identifier Negotiation (Octet 5b)

Bit	
4	
0	Default, LLI = 256 only
1	Full protocol negotiation (Note)

Note: A connection over which protocol negotiation will be executed is indicated in bit 2 of octet 5b.

Assignor/Assignee (Octet 5b)

Bit	
3	
0	Message originator is 'Default assignee'
1	Message originator is 'Assignor only'

In–band/Out–band Negotiation (Octet 5b)

Bit	
2	
0	Negotiation is done with CE INFORMATION messages on a temporary signalling connection
1	Negotiation is done in–band using Logical Link Zero

Number of Stop Bits (Octet 5c)

Bit		
7	**6**	
0	0	Not used
0	1	1 bit
1	0	1.5 bits
1	1	2 bits

Table 61
Low Layer Compatibility Information Element (cont.)

Number of Data Bits Including Parity Bit if Present (Octet 5c)

Bits		
5	**4**	
0	0	Not used
0	1	5 bits
1	0	7 bits
1	1	8 bits

Parity Information (Octet 5c)

Bits			
3	**2**	**1**	
0	0	0	Odd
0	1	0	Even
0	1	1	None
1	0	0	Forced to 0
1	0	1	Forced to 1

All other values are reserved.

Duplex Mode (Octet 5d)

Bit	
7	
0	Half Duplex
1	Full Duplex

Table 61
Low Layer Compatibility Information Element (cont.)

Modem Type (Octet 5d)

Bits						
6	**5**	**4**	**3**	**2**	**1**	
0	0	0	0	0	0	Undefined
0	0	0	0	0	1	V.23 [61]
0	0	0	0	1	0	V.22 bis [60]
0	0	0	0	1	1	V.32 [62]
0	0	0	1	0	0	V.21 [58]
0	0	0	1	0	1	V.22 [59]

Note: The 'Undefined' code point is used when it is only required to define the Duplex Mode.

CE information layer 2 protocol (Octet 6)

Bits					
5	**4**	**3**	**2**	**1**	
0	0	0	0	1	Basic mode ISO 1745 [9]
0	0	0	1	0	ITU–T Rec. Q.921 [47] (I.441 [37])
0	0	1	1	0	ITU–T Rec. X.25 [67] link level
0	0	1	1	1	ITU–T Rec. X.25 [67] Multi link
0	1	0	0	0	Extended LAPB: for half duplex operation (ITU–T Rec. T.71 [52])
0	1	0	0	1	HDLC ARM (ISO 4335 [10])
0	1	0	1	0	HDLC NRM (ISO 4335 [10])
0	1	0	1	1	HDLC ABM (ISO 4335 [10])
0	1	1	0	0	LAN Logical Link control (ISO 8802/2 [15])
0	1	1	0	1	ITU–T Rec. X.75 [70], Single Link Procedure (SLP)

All other values are reserved.

Optional layer 2 protocol information (Octet 6a)

Reserved to be defined by ITU–T.

Table 61
Low Layer Compatibility Information Element (cont.)

CE information layer 3 protocol (Octet 7)

Bits

5	**4**	**3**	**2**	**1**	
0	0	0	1	0	ITU–T Rec. Q.931 [49] (I.451 [39])
0	0	1	1	0	ITU–T Rec. X.25 [67], packet layer
0	0	1	1	1	ISO 8208 [11] (ITU–T Rec. X.25 [67] packet level protocol for data terminal equipment)
0	1	0	0	0	ISO 8348 [12] (OSI connection oriented network service specific subset of ISO 8208 [11] and ITU–T Rec. X.25 [67])
0	1	0	0	1	ISO 8473 [14] (OSI connectionless service)
0	1	0	1	0	ITU–T Rec. T.70 [51] minimum network layer

All other values are reserved.

Optional layer 3 protocol information (Octet 7a)

Reserved to be defined by ITU–T.

5.4.2.3.5.13 Progress Indicator

The purpose of the progress indicator information element is to describe an event which has occurred during the establishment of a call.

The progress indicator information element is coded as shown in Table 62 and Table 63.

Table 62
Progress Indicator Information Element

<table>
<tr><td colspan="8" align="center">Bits</td><td></td></tr>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>Octet</td></tr>
<tr><td rowspan="3">0</td><td colspan="7" align="center">Progress indicator</td><td rowspan="3">1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td colspan="7" align="center">Information element identifier</td></tr>
<tr><td colspan="8" align="center">Length of progress indicator</td><td>2</td></tr>
<tr><td>1
Ext</td><td colspan="2">Coding Standard</td><td>0
Spare</td><td colspan="4" align="center">Location</td><td>3</td></tr>
<tr><td>1
Ext</td><td colspan="7" align="center">Progress description</td><td>4</td></tr>
</table>

Table 63
Progress Indicator Information Element

Octet 3 is coded the same as in the cause information element.

Progress description (Octet 4)

Bits 7	6	5	4	3	2	1	No	Meaning
0	0	0	0	0	0	1	1.	Call is not end–to–end ISDN; further call progress information may be available in–band (Note 1).
0	0	0	0	0	1	0	2.	Destination address is non–ISDN (Note 2)
0	0	0	0	0	1	1	3.	Origination address is non–ISDN (Note 3)
0	0	0	1	0	0	0	8.	In–band information or an appropriate pattern is now available

All other values are reserved.

Note 1: Progress description # 1 indicates interworking with a non–ISDN network.

Note 2: Progress description # 2 indicates the destination CE is non–ISDN equipment.

Note 3: Progress description # 3 indicates the originating CE is non–ISDN equipment.

5.4.2.3.5.14 Restart Indicator

The purpose of the restart indicator is to identify the class of the facility (i.e. channel or interface) to be restarted.

The restart indicator information element is coded as shown in Table 64 and Table 65.

Table 64
Restart Indicator Information Element

				Bits				
8	7	6	5	4	3	2	1	Octet
0	Restart indicator 1	1	1	1	0	0	1 Information element identifier	1
Length of restart indicator contents								2
1	0	0	0	0	Class			3

Table 65
Restart Indicator Information Element

Class (Octet 3)

Bits

3	**2**	**1**	
0	0	0	Indicated channels (Note)
1	1	1	All interfaces

All other values are reserved.

Note: The channel identification information element must be included in the message to indicate which channel is to be restarted.

5.4.2.4 Circuit Switched Call Control Procedures

5.4.2.4.1 General

The procedures of Clauses 5.4.2.4 through 5.4.2.5 of this Standard are applicable only to those messages which pass the checks described in Clauses 5.4.2.4.8.2 to 5.4.2.4.8.6.

The call states referred to in this section cover the states perceived by the network, states perceived by the CE and states which are common to both CE and network. Unless specifically qualified, all states described in the following text and defined in Clause 4.2 should be understood as common.

Detailed specification and description language (SDL) diagrams for the procedures specified in Figures 14 and 17 are contained in Clause 5.4.3. When there is an ambiguity in the narrative text, the SDL diagrams in Figure 17 should be used to resolve conflict. Where the text and the SDL diagrams are in disagreement, the SDL (Network side) diagrams shall take precedence.

This procedure used to establish a call at the destination interface assumes that a data link connection providing services described in Clause 5.3 exists before the first layer 3 message (SETUP) is transferred across the interface. The call reference contained in all messages relating to a call exchanged across the CE–network

interface shall contain the call reference value specified in the SETUP message delivered by the network. The network shall assign the call reference as described in Clause 5.4.2.3.3.

Before the procedures which establish a call at the originating interface are invoked, a reliable data link connection **shall** be established between the CE (NT2) and the network. The data link services described in Clause 5.3 are assumed.

5.4.2.4.2 **Call Establishment at the Originating Interface**

5.4.2.4.2.1 **Call Request**

A CE initiates call establishment by transferring a SETUP message across the CE network interface. Following the transmission of the SETUP message, the call **shall** be considered, by the CE, to be in the Call Init state. The message **shall** always contain a call reference, selected according to the procedures given in Clause 5.4.2.3.3 The bearer capability information element is mandatory in the SETUP message, even in the case of overlap sending.

If the CE knows all appropriate channels controlled by the D–Channel are in use, it **shall not** transfer a SETUP message across the CE–network interface. If the CE does not monitor the status of channels in use, it may send a SETUP message during an all channels busy condition. In this case the network returns a RELEASE COMPLETE message with cause # 34, 'no circuit/channel available'.

Furthermore the SETUP message may also contain all or part of the call information (i.e. called party number) necessary for call establishment depending on whether or not en–bloc or overlap procedures are being used respectively (see Clause 5.4.2.4.2.3.).

If en–bloc sending is used, the SETUP message **shall** contain all the information required from the CE by the network to process the call (i.e. bearer capability, complete called party number and facilities required by the CE for the call).

5.4.2.4.2.2 **B–Channel Selection – Originating**

(a) In the SETUP message, the CE will indicate one of the following in the channel identification information element:

   (i) channel is indicated, no acceptable alternative;

   (ii) channel is indicated, any alternative is acceptable; or

   (iii) any channel is acceptable. If no indication is included alternative (iii) is assumed.

(b) In cases (i) and (ii), if the indicated channel is available, the network selects it for the call.

In case (ii), if the network cannot grant the indicated channel, it selects any other available B–Channel associated with the D–Channel.

In case (iii), the network selects any available B–Channel associated with the D–Channel.

(c) The selected B–Channel is indicated in the first message returned by the network in response to the SETUP message (i.e. SETUP ACKNOWLEDGE or CALL PROCEEDING message). If the first message returned by the network is a SETUP ACKNOWLEDGE, a subsequent CALL PROCEEDING message may also contain a B–Channel indication.

If the B–Channel indicated in the first response message is unacceptable to the CE, it will clear the call by sending a RELEASE message with cause # 6 'channel unacceptable' (see Clause 5.4.2.4.4.2(c)).

(d) After transmitting the message in response to the SETUP message, the network **shall** activate the B–Channel connection. CE **shall** attach to the B–Channel after receiving a CALL PROCEEDING, SETUP ACKNOWLEDGE, PROGRESS or ALERTING message with the progress indicators # 1 or # 8. CE may attach to the B–Channel when the teleservice requested provides ISDN generated tones (see Clause 5.4.2.4.5) after receiving any of the above messages, even if no progress indicator was included. Upon receipt of a CONNECT message, CE not already attached to a B–Channel **shall** attach.

(e) In case (a), if the specified channel is not available, and in cases (b) and (c), if no channel is available, a RELEASE COMPLETE message, with a cause # 44 or # 34 respectively, is sent by the network as described in Clause 5.4.2.4.4.2(a).

Note: Some CE may be restricted to less than 30 B–Channels on their access. Some CE may have requested (by subscription) restrictions on the number of B–Channels that can be used for outgoing calls. The network will reject calls that exceed either of these restrictions, with a cause # 82 included in the RELEASE COMPLETE message.

5.4.2.4.2.3 Overlap Sending

If overlap sending is used, the SETUP message contains either:

(a) no called number information; or

(b) incomplete called number information; or

(c) called number information which the network can not determine to be complete.

On receipt of such a SETUP message, the network starts timer T302 (specified in Clause 5.4.2.4.1), sends a SETUP ACKNOWLEDGE message to the CE and enters the Overlap Sending state. For case (a), the network will also return dial tone as required by the tone option (see Clause 5.4.2.4.5).

When the SETUP ACKNOWLEDGE message is received, the CE enters the Overlap Sending state and optionally starts timer T304 (specified in Clause 5.4.2.4.2).

After receiving the SETUP ACKNOWLEDGE message, the CE sends the remainder of the called number in one or more INFORMATION messages. The called party number information **shall** be provided in the called party number information element.

If the CE employs timer T304, the CE restarts timer T304 when each INFORMATION message is sent.

If dial tone has been returned, it will be terminated by the network on receipt of the first INFORMATION message.

The network **shall** restart timer T302 on the receipt of every INFORMATION message.

5.4.2.4.2.4 **Invalid Call Information**

If following the receipt of a SETUP message or during overlap sending, the network determines that the call information received from the CE is invalid, (e.g. invalid number) then the network **shall** follow the procedures described in Clause 5.4.2.4.8.

5.4.2.4.2.5 **Call Proceeding**

5.4.2.4.2.5.1 **En–bloc Sending**

If en–bloc sending is used, i.e. the network can determine that the SETUP message contains all the information required from the CE to establish the call, the network sends a CALL PROCEEDING message to the CE to acknowledge the SETUP message and to indicate that the call is being processed. At this point the call enters the Outgoing Call Proceeding state.

5.4.2.4.2.5.2 **Overlap Sending**

Following analysis by the network that all call information necessary to effect call establishment has been received, the network **shall**:

(a) send a CALL PROCEEDING message to the CE;

(b) stop timer T302; and

(c) enter the Outgoing Call Proceeding state.

Note: The CALL PROCEEDING message is sent to indicate that the requested call establishment has been initiated, and that no more call establishment information will be accepted.

At the expiration of timer T302, the network **shall**:

(a) initiate call clearing with a cause # 28, in accordance with Clause 5.4.2.4.4.4 if the network determines that the call information is definitely incomplete; otherwise,

(b) send a CALL PROCEEDING message and enter the Outgoing Call Proceeding state.

Note 1: An alerting or connect indication received from the called party will stop timer T302 and cause an ALERTING or CONNECT message respectively to be sent to the calling CE. No CALL PROCEEDING message **shall** be sent by the network.

Note 2: On receipt of a progress indication the network will cause a PROGRESS message to be sent to the calling CE. No state change **shall** occur following the sending or receiving of this message.

5.4.2.4.2.6 **Notification of Interworking at the Originating Interface**

5.4.2.4.2.6.1 **Calls Leaving the ISDN Environment.**

During call establishment, the call may leave the ISDN environment; e.g. because of interworking with another network, with a non–ISDN CE, or with non–ISDN equipment within the called CE's premises.

When such situations occur a progress indication **shall** be returned to the calling CE either:

(a) in an appropriate call control message when a state change is required: CALL PROCEEDING, ALERTING, SETUP ACKNOWLEDGE or CONNECT; or

(b) in the PROGRESS message when no state change is appropriate.

If the progress indication is included in the PROGRESS message, no state change will occur at either side of the interface, but any supervisory CE timers **shall** be stopped.

If indicated by the progress indicator information element, the CE should also monitor the B–Channel, since further call progress signals may be available in–band.

5.4.2.4.2.6.2 **Calls Entering the ISDN Environment**

A call may arrive into an ISDN environment during call establishment; e.g. because of interworking with a non–ISDN CE, or with non–ISDN equipment within the calling CE's premises. When this occurs, the point at which the call enters an ISDN environment **shall** cause a progress indicator information element to be included in the SETUP message.

5.4.2.4.2.7 **Call Confirmation Indication**

Upon receiving an indication that CE alerting has been initiated at the called address, the network transfers an ALERTING message across the CE–network interface of the calling address and the call enters the Call–Delivered state. This message may cause initiation of a CE generated alerting indication. For the

appropriate teleservice, the network will also send ring tone in the connected B–Channel (see Clause 5.4.2.4.5).

5.4.2.4.2.8 **Call Connected**

Upon the network receiving an indication that the call has been accepted, a CONNECT message is sent across the CE–network interface to the calling CE.

This message indicates to the calling CE that a connection has been established through the network and stops any indication of alerting. At this time, the call enters the Active state.

On receipt of the CONNECT message, the calling CE may optionally generate a CONNECT ACKNOWLEDGE message. The network **shall not** take any action on receipt of this message when in the Active state.

5.4.2.4.2.9 **Call Rejection**

Upon receiving an indication that the network (or remote CE) is unable to accept the call, the network will initiate clearing as described in Clause 5.4.2.4.4.4.

5.4.2.4.2.10 **Initiation of Repeated Outgoing Call Attempts**

CE **shall** provide a minimum period of 2 s between automatically initiated successive calls.

A maximum of 10 automatically initiated retries in a repetitive calling sequence **shall** be allowed, i.e. the original call plus nine, provided either an ALERTING or Clearing Message has been received for each call attempt.

If the sequence of calls described above is unsuccessful, i.e. no CONNECT Message received, no further call attempt **shall** be made to obtain the required number until a period of at least 30 min from initiation of the first attempt has lapsed (unless manually initiated).

Compliance with the requirements of initiation of Repeated Outgoing Call Attempts may be checked by operation and inspection.

5.4.2.4.3 **Call Establishment at the Destination Interface**

5.4.2.4.3.1 **Incoming Call**

The network will indicate the arrival of a call at the CE–network interface by transferring a SETUP message across the interface. This message is sent if the network can select an idle B–Channel. In some circumstances the SETUP message may also be sent when no B–Channel is idle.

In addition to the mandatory information elements, the SETUP message may include, as required, the information elements described in Clause 5.4.2.2.3.12 (e.g. display, low layer compatibility, calling party number).

After sending the SETUP message, the network initialises timer T303 (specified in Clause 5.4.2.4.1). The network then enters the Call Present state.

Upon receipt of a SETUP message, the CE will enter the Call Present state.

If no response to the SETUP message is received by the network before the first expiry of timer T303, the SETUP message will be retransmitted and timer T303 restarted.

5.4.2.4.3.2 **Compatibility Checking**

CE receiving a SETUP message **shall** perform compatibility checking before responding to that SETUP message.

A reference to 'CE' in Clauses 5.4.2.4.3.2 to 5.4.2.4.3.7 is a reference to 'compatible CE'.

Incompatible CE **shall** respond with a RELEASE COMPLETE message with cause # 88 'incompatible destination', and enter the Null state. The network processes this RELEASE COMPLETE message as described in Clause 5.4.2.4.3.5.3.

5.4.2.4.3.3 **B–Channel Selection – Destination**

Negotiation for the selection of a B–Channel will be permitted between the network and the CE. Only B–Channels controlled by the same D–Channel will be the subject of the selection procedure. The selection procedure is as follows:

(a) In the channel identification information element of the SETUP message, the network will indicate a preferred B–Channel.

(b) If the indicated channel is acceptable and available, the CE selects it for the call.

If the CE cannot grant the indicated channel, it selects any other available B–Channel associated with the D–Channel.

(c) The selected B–Channel is indicated in a channel identification information element in the first message returned by the CE in response to the SETUP message. A channel identification information element may also be included in ALERTING and CONNECT messages which are not the first message returned in response to a SETUP message. In this case, the network will ignore the contents of that information element.

If the B–Channel indicated in the first response message is unacceptable to the network, it will clear the call by sending a RELEASE message with cause # 6 'channel unacceptable' (See Clause 5.4.2.4.4.2(c)).

(d) When a B–Channel has been selected by the CE, that channel may be connected by the CE.

(e) If no B–Channel is available, the CE returns a RELEASE COMPLETE message with cause # 34, and returns to the Null state.

5.4.2.4.3.4 **Overlap Receiving**

The network does not implement overlap receiving procedures.

When the SETUP ACKNOWLEDGE message is received, the network **shall** consider it to be a non–implemented message (refer Clause 5.4.2.4.8.4.2).

5.4.2.4.3.5 **Call Confirmation**

5.4.2.4.3.5.1 **Response to En–bloc SETUP**

(a) Call Confirmation

When the CE determines that sufficient call set–up information has been received and compatibility requirements have been satisfied, the CE responds to the SETUP message with either an ALERTING, CALL PROCEEDING, or CONNECT message and enters the Call Received, Incoming Call Proceeding, or Connect Request state respectively.

(b) Calls Leaving the ISDN Environment at the Called Interface

During call establishment, the call may leave the ISDN environment; e.g. because of interworking with a non–ISDN CE, or with non–ISDN equipment within the called CE's premises. When such situations occur a progress indication **shall** be sent by the called CE either:

(i) in an appropriate call control message when a state change is required (ALERTING, CONNECT or CALL PROCEEDING) or;

(ii) in the PROGRESS message when no state change is appropriate.

If the progress indication is included in a PROGRESS message no state change will occur at either side of the interface. The network will pass a progress indication received from the called CE to the calling CE in an appropriate message.

(c) Calls arriving in the ISDN Environment

A call may arrive into an ISDN environment during call establishment e.g. because of interworking with another network or as described in Clause 5.4.2.4.2.6.2. When this occurs a progress indicator **shall** be included in the SETUP message sent to the called CE.

(d) Call Rejection

If, following the receipt of a SETUP message, the CE determines that the call information received from the network is invalid (e.g. invalid number), then the CE **shall** follow the procedures described in Clause 5.4.2.4.8.

Busy CE which satisfied the compatibility requirements indicated in the SETUP message **shall** normally respond with a RELEASE COMPLETE message with cause # 17 'CE busy'.

An incompatible CE **shall** respond to the SETUP message by sending a RELEASE COMPLETE message with cause # 88 'incompatible destination'.

If the CE wishes to refuse the call, a RELEASE COMPLETE message **shall** be sent in response to the SETUP message with the

cause # 21 'Call rejected' and the CE returns to the Null state.

5.4.2.4.3.5.2 **Receipt of CALL PROCEEDING**

Receipt of the CALL PROCEEDING message by the network stops timer T303 and starts timer T310 (specified in Clause 5.4.2.5.1). Receipt of an ALERTING or CONNECT message in the case where a CALL PROCEEDING message has not been received stops timer T303. Receipt of an ALERTING, PROGRESS with progress indicator indicating 'Interworking' or CONNECT message subsequent to receipt of a CALL PROCEEDING message stops timer T310.

Receipt of an ALERTING, PROGRESS or CONNECT message causes a corresponding ALERTING, PROGRESS or CONNECT message to be sent to the calling CE.

5.4.2.4.3.5.3 **Call Failure Procedures**

If the network does not receive any valid response to the SETUP message prior to the expiration of timer T303, the SETUP message is re–transmitted. If the network does not receive any valid response to the re–transmitted SETUP message prior to the expiration of a timer T303, or does not receive an ALERTING, CONNECT or DISCONNECT message prior to expiration of timer T310, it will initiate clearing procedures in accordance with Clause 5.4.2.4.4. The clearing cause # 18 'no CE responding' is sent to the calling CE.

If a RELEASE COMPLETE message is received whilst T303 is running or a DISCONNECT message is received whilst T310 is running the message cause **shall** be sent back to the calling CE in a DISCONNECT message.

5.4.2.4.3.6 **Call Acceptance**

The CE indicates acceptance of an incoming call by sending a CONNECT message to the network. Upon sending the CONNECT message the CE **shall** start timer T313 (specified in Clause 5.4.2.5.2).

If a call can be accepted using the B–Channel indicated in the SETUP message, and no CE alerting is required, a CONNECT message may be sent without a previous ALERTING or CALL PROCEEDING message. The CONNECT message contains the call reference value specified in the SETUP message.

5.4.2.4.3.7 **Active Indication**

On receipt of the CONNECT message, the network completes the circuit switched path to the selected B–Channel and subsequently sends a CONNECT ACKNOWLEDGE message to the CE. The network also initiates procedures to send a CONNECT message towards the calling CE.

The CONNECT ACKNOWLEDGE message indicates completion of the circuit switched connection. There may not be end–to–end communications until a CONNECT message is received at the calling CE. Upon receipt of the CONNECT ACKNOWLEDGE message the called CE stops timer T313. At this point, the call enters the Active state where it remains until clearing is initiated.

When T313 expires prior to receipt of a CONNECT ACKNOWLEDGE message the CE **shall** initiate clearing in accordance with Clause 5.4.2.4.4.3.

5.4.2.4.4 Call Clearing

5.4.2.4.4.1 Terminology

The following terms are used in this part of the standard in the description of clearing procedures:

(a) A channel is ‘connected’ when the channel is part of a circuit–switched ISDN connection established according to this standard.

(b) A channel is ‘disconnected’ when the channel is no longer part of a circuit–switched ISDN connection, but is not yet available for use in a new connection.

(c) A channel is ‘released’ when the channel is not part of a circuit–switched ISDN connection and is available for use in a new connection. Similarly, a call reference that is ‘released’ is available for re–use.

5.4.2.4.4.2 Exception Conditions

Under normal conditions call clearing is initiated when the CE or the network sends a DISCONNECT message and follows the procedures defined in Clause 5.4.2.4.4.3 and 5.4.2.4.4.4 respectively. The only exceptions to the above rule are as follows:

(a) In response to a SETUP message, the CE or network can reject a call (e.g. because of the unavailability of a suitable B–Channel) by responding with a RELEASE COMPLETE message provided no other response has previously been sent (e.g. the SETUP ACKNOWLEDGE in the case of overlap sending);

(b) Clearing of on–demand signalling connections will be initiated by sending a RELEASE message as described in Clause 5.4.2.4.4.3 and 5.4.2.4.4.4.

(c) Unsuccessful termination of the B–Channel selection procedure (see Clauses 5.4.2.4.3.3 and 5.4.2.4.2.2.) by the side offering the call is accomplished by:

    (i) sending a RELEASE message;

(ii) starting timer T308;

(iii) entering the Release Request state; and

(iv) continuing as described in Clauses 5.4.2.4.4.3 b(ii) and 5.4.2.4.4.4 b(ii).

The RELEASE message **shall** contain cause # 6 'channel unacceptable'.

(d) In response to an error condition (see Clause 5.4.2.4.8) the CE or network may initiate call clearing by;

(i) sending a RELEASE message;

(ii) starting timer T308;

(iii) entering the Release Request state and continuing as described in Clauses 5.4.2.4.4.3 b(ii) and 5.4.2.4.4.4 b(ii) respectively.

5.4.2.4.4.3 **Clearing by the CE**

5.4.2.4.4.3.1 Apart from the exceptions identified in Clauses 5.4.2.4.4.2 and 5.4.2.4.8, the CE **shall** initiate clearing by:

(a) sending a DISCONNECT message;

(b) starting timer T305 (specified in Clause 5.4.2.5.2);

(c) disconnecting the B–Channel; and

(d) entering the Disconnect Request state.

5.4.2.4.4.3.2 Following the receipt of the DISCONNECT message, the network **shall** consider the call to be in the Disconnect Request state.

5.4.2.4.4.3.3 The network **shall** also initiate procedures to clear the network connection and the call to the remote CE.

(a) On receipt of the DISCONNECT message by the network the B–Channel used in the call **shall** be disconnected in the following manner:

(i) a RELEASE message **shall** be sent to the CE;

(ii) timer T308 (specified in Clause 5.4.2.5.1) **shall** be started; and

(iii) the network **shall** enter the Release Request state.

Note: The RELEASE message has only local significance and does not imply an acknowledgment of clearing from the remote CE.

(b) On receipt of the RELEASE message the CE **shall**:

(i) stop timer T305;

(ii) release the B–Channel;

(iii) send a RELEASE COMPLETE message;

(iv) release the call reference; and

(v) return to the Null state.

(c) Following the receipt of a RELEASE COMPLETE message from the CE, the network **shall**:

(i) stop timer T308;

(ii) release both the B–Channel and the call reference; and

(iii) return to the Null state.

(d) If the CE does not receive a RELEASE message in response to the DISCONNECT message before timer T305 expires, the CE **shall**:

(i) send a RELEASE message to the network with the original cause;

(ii) start timer T308; and

(iii) enter the Release Request state.

5.4.2.4.4.3.4 If a RELEASE COMPLETE message is not received by the network before the first expiry of timer T308, the RELEASE message **shall** be retransmitted with cause # 111 and timer T308 **shall** be restarted. If no RELEASE COMPLETE message is received from the CE before timer T308 expires a second time, the network **shall**:

(a) release the call reference; and

(b) if a B–Channel is assigned, commence channel restart action as described in Clause 5.4.2.4.6.

5.4.2.4.4.4 **Clearing by the Network**

5.4.2.4.4.4.1 Apart from the exceptions identified in Clauses 5.4.2.4.4.2 and 5.4.2.4.8, the network **shall** initiate clearing by:

(a) sending a DISCONNECT message;

(b) disconnecting the B–Channel;

(c) starting timer T305 (specified in Clause 5.4.2.5.1); and

(d) entering the Disconnect Indication State.

5.4.2.4.4.4.2 On receipt of the DISCONNECT message by the CE, the CE **shall**:

(a) disconnect the B–Channel used in the call;

(b) send a RELEASE message to the network;

(c) start timer T308 (specified in Clause 5.4.2.5.2); and

(d) enter the Release Request state.

5.4.2.4.4.4.3 On receipt of the RELEASE message, the network **shall**:

(a) stop timer T305;

(b) release the B–Channel;

(c) send a RELEASE COMPLETE message;

(d) release the call reference; and

(e) return to the Null state.

5.4.2.4.4.4.4 Following the receipt of a RELEASE COMPLETE message from the network, the CE **shall**:

(a) stop timer T308:

(b) release both the B–Channel and the call reference; and

(c) return to the Null state.

5.4.2.4.4.4.5 If the network does not receive a RELEASE message in response to the DISCONNECT message before timer T305 expires, it **shall**:

(a) send a RELEASE message to the CE with the original cause;

(b) start timer T308; and

(c) enter the Release Request state.

5.4.2.4.4.4.6 If a RELEASE COMPLETE message is not received by the CE before the first expiry of T308, the CE will retransmit the RELEASE message with cause # 111 and restart timer T308. If no RELEASE COMPLETE is received from the network before timer T308 expires a second time, the CE **shall**:

(a) release the call reference; and

(b) if a B–Channel is assigned, optionally commence channel restart action as described in Clause 5.4.2.4.6.

5.4.2.4.4.5 **Clear Collision**

5.4.2.4.4.5.1 Clear collision occurs when the CE and the network simultaneously transfer a DISCONNECT message specifying the same call. Under these conditions both the CE and the network **shall**:

(a) stop timer T305;

(b) send a RELEASE message;

(c) start timer T308; and

(d) enter the Release Request state and continue as described in Clause 5.4.2.4.5.5(b).

5.4.2.4.4.5.2 Clear collision can also occur when both sides simultaneously transfer RELEASE messages related to the same call. The entity receiving such a RELEASE message whilst within the Release Request state **shall**:

(a) stop timer T308;

(b) release the call reference; and

(c) enter the Null state (without sending a RELEASE COMPLETE message).

5.4.2.4.5 **In–band Tones and Announcements**

5.4.2.4.6 **Overview**

If it has been indicated that the CE desires in–band tones/announcements then in-band tones/announcements will be provided as call progress information. The request for provision of in–band tones/announcements is implicit in the request for an appropriate telecommunication service.

5.4.2.4.6.1 **Tones and Announcements during Call Establishment**

5.4.2.4.5.2.1 For appropriate telecommunication services, at the calling CE–network interface dial tone **shall** be sent by the network in the selected B–Channel, simultaneously with the SETUP ACKNOWLEDGE message, where the SETUP message contained no called number information (see Clause 5.4.2.4.2.3). The network will stop sending dial tone when the following occurs:

(a) receipt of the first INFORMATION message from the CE; or

(b) expiry of timer T302; or

(c) the network decides to proceed with the call (and send a CALL PROCEEDING message).

5.4.2.4.5.2.2 For appropriate telecommunication services, for calls within the ISDN ring tone **shall** be sent by the network in the selected B–Channel, simultaneously with the ALERTING message. The network will stop sending ring tone on receipt of a connect indication from the network.

5.4.2.4.5.2.3 At the calling CE–network interface, for the appropriate telecommunication services, other in–band tones and announcements may be generated by the network (e.g. interworking with the PSTN).

5.4.2.4.5.2.4 Before entering the active state, in–band tones and announcements, not associated with a call state change, **shall** result in a PROGRESS message being sent by the network to the calling CE simultaneously with the application of the in–band tone or announcement. The PROGRESS message may contain either:

(a) progress indicator # 1 'call is not end–to–end ISDN: further call progress information may be available in–band'; or

(b) progress indicator # 8 'in–band information or an appropriate pattern is now available'.

5.4.2.4.5.2.5 The sending of the PROGRESS message by the network or the receipt of the PROGRESS message by the calling CE **shall** cause no state change. The CE on receipt of a PROGRESS message with either of the above progress indicators will connect to the B–Channel if it had not already done so.

5.4.2.4.5.2.6 When in–band tones and announcements are to be provided by the network together with a call state change, the progress indicator **shall** be included in the appropriate message (e.g. CALL PROCEEDING) sent by the network.

5.4.2.4.6.2 **Tones and Announcements for Call Failure**

For in–band tones/announcements relating to call failure (e.g. busy) before reaching the Active state, the network **shall** send a DISCONNECT message simultaneously with the application of the in–band tone/announcement. The DISCONNECT message **shall** contain the corresponding cause of the call failure and the progress indicator # 8 'in–band information or appropriate pattern is now available'.

The network on sending the DISCONNECT message **shall** initiate timer T306 and enter the Disconnect Indication state. Following the receipt of the DISCONNECT message from the network the CE **shall** enter the Disconnect Indication state.

Prior to the expiry of timer T306 the CE may pursue the call clearing by sending a RELEASE message.

On expiry of timer T306 the network **shall** initiate clearing by sending a RELEASE message and follow the procedure described in Clause 5.4.2.4.4.3.3.

5.4.2.4.7 **Restart Procedure**

5.4.2.4.7.1 **Overview**

The restart procedure is used to return calls to the Null state or the interface to an idle condition. The procedure is invoked when a major failure has occurred affecting all calls on the interface or a failure condition requiring restart of a particular call (e.g. following the second expiry of timer T308 due to the absence of response to RELEASE messages).

5.4.2.4.7.2 **Sending RESTART**

A RESTART message is sent by the network or CE in order to return calls to the Null state or the interface to an idle condition. The Restart Indicator information element is used to indicate whether the restart procedure applies to a specific

B–Channel or to all calls on the interface. The channel identification information element must be present in the RESTART message when a call on a specified channel is to be returned to the Null state.

Upon transmitting the RESTART message the sender starts timer T316 and waits for a RESTART ACKNOWLEDGE message. Receipt of a RESTART ACKNOWLEDGE message stops timer T316 and frees the channels and call reference values for reuse.

If a RESTART ACKNOWLEDGE message is not received prior to the expiry of timer T316, subsequent RESTART messages may be sent N316 – 1 times until a RESTART ACKNOWLEDGE message is returned. Meanwhile, no calls **shall** be placed or accepted over the identified channel or the interface by the originator of the RESTART message. If no RESTART ACKNOWLEDGE message is returned, local maintenance action will be initiated and the channel or interface is considered to be in an out–of–service condition. The values of timer T316 and counter N316 are specified in Clause 5.4.2.5.

The CE or network should not send another RESTART message while timer T316 is running.

5.4.2.4.7.3 **Receipt of RESTART**

Upon receiving a RESTART message the recipient **shall** return the call on the specified channel to the Null state or the interface to an idle condition and then send a RESTART ACKNOWLEDGE message to the originator. If the interface is specified all calls over that interface will be returned to the Null state. A local timer T317 **shall** be started on receipt of the RESTART Message. If this timer expires before the interface is returned to an idle condition or the calls are returned to the Null state, local maintenance action may be initiated and the channel or interface considered to be in an out–of–service condition.

5.4.2.4.7.4 **RESTART Collision**

In the case of a restart collision, the restart procedure initiated by the network **shall** take precedence.

If the network sends a RESTART message and receives a RESTART message from the CE before receipt of a RESTART ACKNOWLEDGE, the received RESTART message will be ignored.

If the CE sends a RESTART message and receives a RESTART message from the network before receipt of a RESTART ACKNOWLEDGE, the CE **shall** stop timer T316 and action the RESTART message as described in Clause 5.4.2.4.6.3. The CE may then re–initiate the CE–originated restart procedures.

5.4.2.4.8 Call Collision

Call collisions as such cannot occur in the network. Simultaneous incoming or outgoing calls are dealt with separately and assigned different call references. Channel selection conflicts may occur if more than one call (incoming or outgoing) requires the same channel. In the case of such conflicts, the network will give priority to the incoming call. Channel selection mechanisms are described in Clauses 5.4.2.4.2.2 and 5.4.2.4.3.3. If only one B–Channel is available, the network **shall** give an incoming call preference over a call request received from the CE and the CE **shall** give preference to the network for call establishment.

5.4.2.4.9 Handling of Error Conditions

5.4.2.4.9.1 Overview

The procedures of all Clauses of this Technical Standard are applicable only to those messages which pass the checks described in Clauses 5.4.2.4.8.1 to 5.4.2.4.8.5.

Note: It is recognised that it may be undesirable or impractical to perform all error checking prior to the call control process accepting a message. Therefore, the checking of messages for invalid or corrupted contents may be performed subsequently to handling by the call control process provided that the behaviour at the CE network interface remains unchanged.

Capabilities facilitating the orderly treatment of error conditions are provided for in this section.

Under several conditions, STATUS messages are transmitted across the interface. The STATUS message can be solicited by sending a STATUS ENQUIRY message or sent following the detection of various error conditions defined in this section. In the former case the STATUS message will contain the cause value # 30 'response to a STATUS ENQUIRY'. The STATUS message must also include the Call State information element. If a STATUS message is transmitted as a result of one of the procedures described in this section then the Call State information element **shall** contain the state number of the next state the protocol will enter, after completing the current transition.

If, during the checking of a layer 3 message, several errors are detected for which the sending of a STATUS message is specified, only the first error that is detected need be reported by a STATUS message. Furthermore, if, for at least one of the errors detected, call clearing is specified, no STATUS message need be sent reporting any other error.

It should be noted that the network may send valid messages or information elements not defined within this Technical Standard, but defined within network Managers' Specifications issued by individual Managers, relating to network features beyond the scope of this Technical Standard. The handling of these additional protocol elements is implementation dependent.

CE may either accept these protocol elements and process them in accordance with the applicable Network Manager's Specification or treat them according to the error handling procedures in Clause 5.4.2.4.8.

On receipt of a layer 3 D–Channel message, the following rules apply in order of precedence.

5.4.2.4.9.2 **Protocol Discriminator Error**

When a message is received with a protocol discriminator not in accordance with Clause 5.4.2.3.2, that message **shall** be ignored.

The side receiving the message **shall** not act upon any part of the message and **shall** remain in the state in which the message was received.

5.4.2.4.9.3 **Message Too Short**

When a message is received that is too short to contain a complete message type information element (i.e. less than five octets) that message **shall** be ignored.

The side receiving the message **shall** not act upon any part of the message and **shall** remain in the state in which the message was received.

5.4.2.4.9.4 **Call Reference Error**

5.4.2.4.9.4.1 **Invalid Call Reference Format**

If the call reference information element octet 1, bits 8 through 5 do not equal '0000', then the message **shall** be ignored.

If the call reference information element octet 1, bits 4 through 1 indicate a length not equal to two, then the message **shall** be ignored.

5.4.2.4.9.4.2 **Call Reference Procedural Error**

Whenever the network or CE receives any message, except a RESTART or RESTART ACK, specifying the global call reference (refer to Clause 5.4.2.3.3 for a definition of the global call reference), that message **shall** be ignored.

Whenever the network receives any message except SETUP, RELEASE or RELEASE COMPLETE, specifying a call reference which it does not recognise as relating to an active call or a call in progress, it initiates clearing by: sending a RELEASE message with cause # 81 'invalid call reference value' specifying the call reference in the received message; starting timer T308; entering the Release Request state; and following the procedures described in Clause 5.4.2.4.4.3.3. On receipt of the RELEASE message the CE **shall**: send a RELEASE COMPLETE message; release the call reference and return to the null state.

Alternatively, the receiving entity may send a RELEASE COMPLETE message with cause # 81 'invalid call reference value' and remain in the Null state.

Whenever the CE receives any message except SETUP, RELEASE and RELEASE COMPLETE specifying a call reference which it does not recognise as relating to an active call or a call in progress, it initiates clearing by: sending a RELEASE message with cause # 81 'invalid call reference value' specifying the call reference in the received message; starting timer T308; entering the Release Request state; and following the procedures described RELEASE COMPLETE message in Clause 5.4.2.4.4.4.4. On receipt of the RELEASE message the network **shall**: send a RELEASE COMPLETE message; release the call reference and return to the null state.

Alternatively, the receiving entity may send a RELEASE COMPLETE message with cause # 81 'invalid call reference value' and remain in the Null state.

If the network or CE receives a RELEASE message specifying a call reference which it does not recognise as relating to an active call or a call in progress, a RELEASE COMPLETE message with cause # 81 'invalid call reference value' is returned, specifying the call reference in the received message.

If the network or CE receives a RELEASE COMPLETE message specifying a call reference which it does not recognise as relating to an active call or a call in progress, no action **shall** be taken.

Whenever the network receives a SETUP message or the CE receives a SETUP message specifying a call reference which is not recognised as relating to an active call or to a call in progress and with a call reference flag set to '1', that message **shall** be ignored.

5.4.2.4.9.5 Message Type or Message Sequence Errors

5.4.2.4.9.5.1 Message Type Not Implemented

Whenever an unrecognised message is received (i.e. the message type is

non–implemented or non–existent) in any state other than the Null state (the action to take in the Null state is described in Clause 5.4.2.4.8.2) a STATUS message with cause # 97 'message type non–existent or not implemented' **shall** be sent. Alternatively, the STATUS message may contain cause # 98 'message type not compatible with call state or message type non–existent or not implemented'.

5.4.2.4.9.5.2 Message Incompatible with Call State

Whenever an unexpected message, except RELEASE or RELEASE COMPLETE (i.e. one for which no response is prescribed in the procedures) is received by the CE or the network in any state other than the Null, state a STATUS message with the cause value # 101 'message type not compatible with call state' **shall** be sent. No state change **shall** occur as the result of this action.

The action to be taken in the Null state is described in Clause 5.4.2.4.8.2. As an option, when in the Disconnect Request state, Disconnect Indication state or the Release Request state, no action need be taken on receipt of an unexpected message.

However, two exceptions to this procedure exist. The first exception to this procedure is when the network or CE receives an unexpected RELEASE message (e.g. if the DISCONNECT message was corrupted by undetected transmission errors). Whenever the network receives an unexpected RELEASE message, the network **shall**:

(a) disconnect and release the B–Channel;

(b) clear the network connection and the call to the remote CE;

(c) return a RELEASE COMPLETE message to the CE; and

(d) release the call reference and enter the Null state.

Whenever the CE receives an unexpected RELEASE message, the CE **shall**:

(a) disconnect and release the B–Channel;

(b) return a RELEASE COMPLETE message to the network; and

(c) release the call reference and enter the Null state.

The second exception is when the network or CE receives an unexpected RELEASE COMPLETE message.

Whenever the network receives an unexpected RELEASE COMPLETE message, the network **shall**:

(a) disconnect and release the B–Channel;

(b) clear the network connection and the call to the remote CE;

(c) release the call reference;

(d) stop all timers; and

(e) enter the Null state.

Whenever the CE receives an unexpected RELEASE COMPLETE message, the CE **shall**:

(a) disconnect and release the B–Channel;

(b) release the call reference;

(c) stop all timers; and

(d) enter the Null state.

5.4.2.4.9.6 **Information Element Errors**

5.4.2.4.9.6.1 **Essential Information Element Missing**

An 'essential' information element is one which is either a 'mandatory' information element, or an 'optional' information element which must be included in the given situation, as indicated for each message in Clause 5.4.2 with an appropriate note.

Whenever a message is received with either the Protocol Discriminator, Call Reference or Message type information elements missing the action to be taken is described in Clauses 5.4.2.4.8.2, 5.4.2.4.8.3 and 5.4.2.4.8.4 respectively.

When a message is received which has one or more other essential information elements missing, Table 65 **shall** be consulted. The action to take depends on what type of information element is missing and what type of message the information element is encoded in. If the action included sending a message containing the cause information element, cause # 96 'mandatory information element missing' **shall** be used. The information element identifier of the missing information element will be included in the diagnostic field. In the event of multiple essential information elements missing, the diagnostic **shall** include the information element identifier of the first essential information element that is identified as not being present.

Alternatively, when a message other than SETUP, DISCONNECT, RELEASE or RELEASE COMPLETE is received which has one or more mandatory information elements missing, no action should be taken on the message and no state change should occur. A STATUS message is then returned with cause # 96 'mandatory information element is missing'.

5.4.2.4.9.6.2 Essential Information Element Content Error

Whenever a message is received with either the Protocol Discriminator, Call Reference or Message type information elements invalid or corrupted the action to be taken is described in Clauses 5.4.2.4.8.2, 5.4.2.4.8.3 and 5.4.2.4.8.4 respectively.

When a message is received that contains any other essential information element with an invalid format Table 66 **shall** be consulted to establish the required response. For undefined content errors which affect the correct operation of the protocol, Table 66 **shall** be consulted to establish the required response. Undefined content means the use of code points not described by this standard. The most suitable cause available **shall** be included in the response. Cause # 100 'invalid information element contents' is a general cause and should only be used if no better cause can be found.

Alternatively, when a message other than SETUP, DISCONNECT, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements with invalid content, no action should be taken on the message and no state change should occur. A STATUS message is then returned with cause # 100 'invalid information element contents'.

Note: The preferred alternative for errors in the STATUS message, is to use Table 66. This avoids the potential for lockup where both ends send STATUS with error.

5.4.2.4.9.6.3 Information Element Not Implemented

When the CE or network receives a message containing an information element that it does not know how to act upon, it **shall** act on the message and those information elements that it can action. Furthermore for messages other than RELEASE COMPLETE, a STATUS message may be returned containing a cause information element indicating the non–implemented information elements. When more than one non–implemented information element is detected, a cause information element may be included in the STATUS message for each non–implemented information element. Each cause information element **shall** contain the cause # 99 'information element non–existent or not implemented' and the diagnostic field **shall** contain the unrecognised information element identifier.

If a RELEASE COMPLETE message is received which has one or more unrecognised information elements, no action **shall** be taken on the unrecognised information.

5.4.2.4.9.6.4 **Non–essential Information Element Content Error**

When a message is received that contains one or more information elements with invalid format or undefined content which affect the correct operation of the protocol, Table 67 **shall** be consulted to establish the required response, as detailed in the legend following the table. Undefined content means the use of code points not described by this standard. The most suitable cause available **shall** be included in the response. Cause # 100 'invalid information element contents' is a general cause and should only be used if no better cause can be found.

Alternatively, action **shall** be taken on the message and those information elements which are recognized and have valid contents. In this case a STATUS message may be returned containing one cause information element. The cause information element **shall** contain cause # 100 'invalid information element contents'.

5.4.2.4.9.6.5 **Information Element Length Error**

When a message is received in any state other than the Null state and its length does not agree with the length indicated by the different information element length indicators, e.g. an information element is incomplete, then a STATUS message **shall** be sent with cause # 95 'invalid message, unspecified' and the message processing will continue.

If received in the Null state, the call will be cleared by returning a RELEASE COMPLETE message. The cause information element will indicate cause # 95 'invalid message, unspecified'.

Alternatively, take the action specified for an IE Contents Error (see Clauses 5.4.2.4.8.6 and 5.4.2.4.8.6.4), except cause # 95 **shall** be used.

5.4.2.4.9.7 **Data Link Reset**

Whenever layer 3 of the CE side is informed of a spontaneous data link layer reset, by means of the DL–ESTABLISH–INDICATION, the following may apply:

(a) The calls in the Overlap Sending state **shall** be cleared by the network as described in Clause 5.4.2.4.4.4 with the cause # 41 'temporary failure'.

(b) The calls in the establishment, Active states are maintained but in addition, a STATUS ENQUIRY message **shall** be sent to verify the call state of the peer entity.

(c) The calls in all other states are not affected.

Note: On the network side the above requirement is mandatory.

5.4.2.4.9.8 **Data Link Failure**

5.4.2.4.8.8.1 Whenever the layer 3 entity is notified by its data link layer entity via the

DL–RELEASE INDICATION that there is a data link layer malfunction, the following **shall** apply:

(a) The calls in the Overlap Sending state **shall** be internally cleared.

(b) For those calls without a timer running (see Clause 5.4.2.5) a timer T309 **shall** be started; if T309 is already running it **shall not** be restarted (the value of T309 is specified in Clause 5.4.2.5. (Implementation of timer T309 at the CE side is optional, but desirable).

If timer T309 expires the layer 3 entity should begin its own internal clearing procedures of all calls relating to the failed data link.

(c) Layer 3 **shall** request layer 2 re–establishment by sending DL–ESTABLISH REQUEST.

5.4.2.4.8.8.2 When informed of layer 2 re–establishment, by means of a DL–ESTABLISH–CONFIRM:

(a) if timer T309 is running, it **shall** be stopped; the network, and optionally the CE, **shall** send STATUS ENQUIRY message(s) to verify the call state(s) of the peer entity.

(b) if timer T309 has expired, the layer 3 entity should initiate restart action as specified in Clause 5.4.2.4.6.

(c) if CE timer T309 is not implemented, no action by the CE is required.

5.4.2.4.9.9 **STATUS ENQUIRY Procedure**

Whenever an entity wishes to check the correctness of a call state at a peer entity, a STATUS ENQUIRY message may be sent requesting the call state. In addition the STATUS ENQUIRY message **shall** be sent as described in Clauses 5.4.2.4.8.7 and 5.4.2.4.8.8.

Upon receipt of a STATUS ENQUIRY message, the receiver **shall** respond with a STATUS message, reporting the call state at the completion of the current transition and indicating that the message was sent in reply to a STATUS ENQUIRY message by indicating cause # 30 'Response to STATUS ENQUIRY'. Receipt of the STATUS ENQUIRY message does not result in a state change.

Sending the STATUS message in such a situation will not directly affect the call state of the sender.

5.4.2.4.9.10 Receiving a STATUS Message in Response to a STATUS ENQUIRY

If the CE receives a STATUS message indicating cause # 30 'response to STATUS ENQUIRY' the CE **shall** consult Table 68 in order to ascertain whether the two peer entities are in compatible states. If the network receives a STATUS message indicating cause # 30 'Response to STATUS ENQUIRY', the network **shall** consult Table 69. Depending on the state of the call of the two peer entities several actions are described in the tables.

If call clearing is to be initiated then an appropriate cause **shall** be included in the first message sent in response to the STATUS message. Cause # 101 'message not compatible with call state' should be used unless a more appropriate cause is available.

Table 66
Procedure on Identification of Invalid or Corrupted or Non–essential Information Elements

Message	Information Element							
	BEARER CAPABILITY	CAUSE	CALL STATE	CHANNEL IDENTIFICATION	PROGRESS INDICATOR	DISPLAY	RESTART INDICATOR	CALLED PARTY NUMBER
ALERTING				R				
CALL PROCEEDING				R				
CONNECT				R				
DICONNECT		SP						
INFORMATION						S		R
PROGRESS					R			
RELEASE		RC						
RELEASE COMPLETE		N						
RESTART				I			I	
RESTART ACKNOWLEDGE				I			I	
SETUP	RC			RC				RC
SETUP ACKNOWLEDGE				R				
STATUS		R	R					

Legend

R Release: Initiate clearing by sending a RELEASE message, starting T308 and entering state 19. The procedures are described in Clause 5.4.2.4.4.2(d).

RC Release Complete: Initiate clearing by sending RELEASE COMPLETE message. Following this, the call reference **shall** be released and the call **shall** enter the NULL state.

S Remain in the same state and return a STATUS message.

SP Continue to process the message and return a STATUS message.

N Continue to process the message; take no further action.

I Ignore the message and stay in the same state.

Table 67
Procedure on Identification of Invalid or Corrupted Non–essential Information Elements

Message	CAUSE	CHANNEL IDENTIFICATION	PROGRESS INDICATOR	NOTIFICATION INDICATOR	DISPLAY	CALLING PARTY NUMBER	CALLING PARTY SUB-ADDRESS	CALLED PARTY NUMBER	CALLED PARTY SUB-ADDRESS	LOW LAYER COMPATIBILITY	HIGH LAYER COMPATIBILITY
ALERTING		R	R		SP						
CALL PROCEEDING		R	R		SP						
CONNECT		R	R		SP						
CONNECT ACKNOWLEDGE					SP						
DICONNECT			SP		SP						
NOTIFY					SP						
PROGRESS					SP						
RELEASE	RC				RC						
RELEASE COMPLETE	N				N						
RESTART		I			N						
RESTART ACKNOWLEDGE		I			N						
SETUP		RC	RC		SP	SP	SP	RC	SP	SP	SP
SETUP ACKNOWLEDGE			R		SP						
STATUS					N						
STATUS ENQUIRY					SP						

Legend

R	Release: Initiate clearing by sending a RELEASE message, starting T308 and entering state 19. The procedures are described in Clause 5.4.2.4.4.2(d).
RC	Release Complete: Initiate clearing by sending RELEASE COMPLETE message. Following this, the call reference **shall** be released and the call **shall** enter the NULL state.
S	Remain in the same state and return a STATUS message.
SP	Continue to process the message and return a STATUS message.
N	Continue to process the message; take no further action.
I	Ignore the message and stay in the same state.

Table 68
User Side: Procedure on receipt of
a STATUS MESSAGE in response to a STATUS ENQUIRY MESSAGE

State reported by STATUS message		U0 NULL	U1 CALL INITIATED	U2 OVERLAP SENDING	U3 OUTGOING CALL PROCEDDING	U4 CALL DIVERTED	U6 CALL PRESENT	U7 CALL RECEIVED	U8 CONNECT REQUEST	U9 INCOING CALL REQUEST	U10 ACTIVE	U11 DISCONNECT INDICATION	U12 DISCONNECT REQUEST	U19 RELEASE REQUEST
NULL	N0	R	C	C	C	C	C	C	C	C	C	C	C	C
CALL INITIATED	N1	R	*	R	R	R	R	R	R	R	R	N[2]		N[2]
OVERLAP SENDING	N2	R	R	*	R	R	R	R	R	R	R	N[2]		N[2]
OUTGOING CALL PROCEDDING	N3	R	R	R	*	R	R	R	R	R	R	N[2]		N[2]
CALL DIVERTED	N4	R	R	R	R	*	R	R	R	R	R	N[2]		N[2]
CALL PRESENT	N6	R	RC	RC	RC	RC	*	RC	RC	RC	RC	RC	RC	RC
CALL RECEIVED	N7	R	R	R	R	R	R	*	R	R	R	N[2]	R	N[2]
CONNECT REQUEST	N8	R	R	R	R	R	R	R	*	R	R	N[2]	R	N[2]
INCOING CALL REQUEST	N9	R	R	R	R	R	R	R	R	*	R	R	R	N[2]
ACTIVE	N10	R	R	R	R	R	R	R	R	R	*	N[2]	R	N[2]
DISCONNECT INDICATION	N11	R	R	R	R	R	R	R	R	R	R	*	R	N[2]
DISCONNECT REQUEST	N12	R	R	R	R	R	R	R	R	R	R	R	*	N[2]
RELEASE REQUEST	N19	R	RC	RC	RC	RC	RC	RC	RC	RC	RC	RC	N[2]	RC

Table 69
Procedure on Identification of Invalid or Corrupted Non–essential Information Elements

		State reported by STATUS message												
Network Side State		U0 NULL	U1 CALL INITIATED	U2 OVERLAP SENDING	U3 OUTGOING CALL PROCEDDING	U4 CALL DIVERTED	U6 CALL PRESENT	U7 CALL RECEIVED	U8 CONNECT REQUEST	U9 INCOING CALL REQUEST	U10 ACTIVE	U11 DISCONNECT INDICATION	U12 DISCONNECT REQUEST	U19 RELEASE REQUEST
NULL	N0	R	R	R	R	R	R	R	R	R	R	R	R	RC
CALL INITIATED	N1	C	*	R	R	R	R	R	R	R	R	R	R	RC
OVERLAP SENDING	N2	C	RC	*	R	R	R	R	R	R	R	N[2]	R	RC
OUTGOING CALL PROCEDDING	N3	C	RC	R	*	R	R	R	R	R	R	N[2]	R	RC
CALL DIVERTED	N4	C	RC	R	R	*	R	R	R	R	R	N[2]	R	RC
CALL PRESENT	N6	C	RC	R	R	R	*	R	R	R	R	R	R	RC
CALL RECEIVED	N7	C	RC	R	R	R	R	*	R	R	R	N[2]	R	RC
CONNECT REQUEST	N8	C	RC	R	R	R	R	R	*	R	R	N[2]	R	RC
INCOING CALL REQUEST	N9	C	RC	R	R	R	R	R	R	*	R	R	R	RC
ACTIVE	N10	C	RC	R	R	R	R	R	R	R	*	N[2]	R	RC
DISCONNECT INDICATION	N11	C	RC	R	R	R	R	R	R	R	R	*	R	RC
DISCONNECT REQUEST	N12	C	RC	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	*	RC
RELEASE REQUEST	N19	C	RC	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	N[1]	*

Legend and Notes for Tables 68 and 69

These tables indicate how a side receiving a STATUS MESSAGE in response to a STATUS ENQUIRY MESSAGE will react.

Legend:

*	Both Layer 3 entities are in compatible states. No action is required.
R	The two Layer 3 entities are not in compatible states. Clearing should be initiated by sending a RELEASE message. If the network initiates clearing then the procedures as described in Clause 5.4.2.4.4.3.3 are appropriate. If the CE is initiating clearing then the procedures described in Clause 5.4.2.4.4.4.2 are appropriate.
RC	The two Layer 3 entities are not in compatible states. Clearing should be performed by sending a RELEASE COMPLETE message, after which the side sending the message can consider the call as being the Null state.
N	No action required. Refer to the note associated with this entry.
C	The remote end is already in the Null state. The call is internally cleared locally, and the B–Channel (if necessary) and call reference are released for reuse.
Note 1:	No action required. The network is currently attempting to clear the call.
Note 2:	No action required. The CE is currently attempting to clear the call.

5.4.2.5 **System Parameters**

5.4.2.5.1 **Timers and Counters in the Network Side**

Timer No.	Time Out Value	State	Cause For Initiation	Normal Termination	At the First Expiry	At the Second Expiry
T302	10s	N2	Call is in overlap sending mode	At the receipt of INFO message from the CE, or network alert, connect or call proceeding request	Call handling notified	Timer is restarted after every receipt of INFO
T303	4s	N6	SETUP is transmitted to the CE	ALERTING, CONNECT or CALL PROCEEDING from the CE	Retransmit SETUP and reinitialise T303	Return call reference to Null state
T305	30s	N12	Network sends DISCONNECT without progress indicator #8	RELEASE, or DISCONNECT from the CE	Network sends RELEASE to the CE	Timer is not reinitialised
T306	60s (Note 1)	N12	Network sends DISCONNECT with progress indicator #8	DISCONNECT, or release from the CE	Network sends RELEASE to the CE	Timer is not reinitialised
T308	4s	N19	Network sends RELEASE to the CE	RELEASE COMPLETE from the CE	Retransmit RELEASE and reinitialise T308	Network releases the B–Channel and call reference value and sends a channel restart
T309	15s	N3, 4, 7, 8–10	Data link layer disconnection. Calls in stable states are not lost	When data link layer is reconnected	Clear the calls	Timer is not reinitialised
T310	10s	N9	Network has received CALL PROCEEDING message from CE	ALERTING, CONNECT, PROGRESS or DISCONNECT from CE	Network clears the call	Timer is not reinitialised
T316	30s	R1	Network sends RESTART to the CE	RESTART ACKNOWLEDGE from CE	Retransmit RESTART and reinitialised T316	Maintenance action after N316 times
T317	less than T316	R2	Network receives RESTART message	RESTART ACKNOWLEDGE sent to CE	Maintenance action	Timer is not reinitialised
N316	2	R1				

Note: Timeout value indicated applies for tone sending. For announcements the timeout value can be set per announcement applied.

5.4.2.5.2 Timers and Counters in the CE Side

Timer No.	Time Out Value	State	Cause For Initiation	Normal Termination	At the First Expiry	At the Second Expiry
T304	15s	U2	Call is in overlap sending state		Clear the call	
T305	30s	U11	CE sends DISCONNECT to clear the call	RELEASE from the network	CE sends RELEASE	Timer is not reinitialised
T308	4s	U19	CE sends RELEASE to the network	RELEASE COMPLETE from the network	Retransmits RELEASE and reinitialises T308	CE releases the B–Channel and call reference value and optionally sends a channel restart
T309 option	15s	U3,4,7 8–10	Data link layer disconnection. Calls in stable states are not lost.	When data link layer is reconnected	Clear the calls	Timer is not reinitialised
T313	4s	U8	CONNECT is transmitted to the network	At the receipt of CONNECT ACKNOWLEDGE from the network	CE sends DISCONNECT to the network	Timer is not reinitialised
T316	30s	R2	CE sends RESTART to the network	RESTART ACKNOWLEDGE from the network	Retransmits RESTART and reinitialise T316	Maintenance Action after N316 times
T317	less than T316	R1	CE receives RESTART message	RESTART ACKNOWLEDGE sent to the network	Maintenance action	Timer is not reinitialised
N316	2	R2				

5.4.3 Primary Rate Access, ISDN CE-Network Interface Layer 3 SDL Diagrams

5.4.3.1 General

This section provides an SDL representation of the CE side layer 3 protocol. The SDL representation of the layer 3 processes is definitive in case of ambiguities or conflict with the text of Clause 5.4.2.4. The SDL representation does not constrain implementations from exploiting the full scope of the procedures as presented within the text of this standard.

5.4.3.2 Layer 3 Architecture

A typical architecture for the layer 3 entity of the CE side of the primary rate

CE–network interface is shown in Figure 16. This architecture depicts the processes among which the various layer 3 functions are distributed, in addition to specifying the interactions between layer 3 and layer 2.

A possible distribution of the layer 3 functions amongst the various processes is as follows:

(a) Director Process

(i) Creation of some of the other processes

(ii) Transfer of layer 3 messages to layer 2 (via message units). Receipt of layer 2 message units and the transfer of the layer 3 messages contained to the appropriate process. This can also involve some state independent error checking.

(iii) Management of call references for the interface.

(iv) Message routing

(b) Restart Process

(i) Used when a failure has occurred affecting either the entire interface or a single call to return calls to the null state or the interface to an idle condition.

(c) Call Control Process (CCP)

(i) Used to implement the call control protocol for a particular call currently in progress on the interface. Therefore multiple instances of CCPs may exist at any one time.

(ii) Handles state dependent error checking for a particular call.

(d) Call Handling Process

(i) Provides functions associated with establishing maintaining and releasing calls on the interface.

(ii) Provides functions associated with interworking with the upper layer on the CE side.

(e) Layer Management Process

(i) Provides management of layer 3 resources;

(ii) Provides functions associated with interworking with a system management entity.

The SDL representation in this part does not describe all of these functions as only the CCP and Restart Process have been represented.

For the CCP process the representation is given in Clause 5.4.3.3(S2).

5.4.3.3 Process Interactions

The interactions between layer 2 and layer 3 are effected by the following signals:

S1 [DL–ESTABLISH–INDICATION

DL–ESTABLISH–CONFIRM

DL–DATA–INDICATION

DL–RELEASE–INDICATION

DL–RELEASE–CONFIRM]

S2 [DL–ESLABLISH–REQUEST

DL–DATA–REQUEST

DL–RELEASE–REQUEST]

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6 TESTING

6.1 General

6.1.1 Standard Test Conditions

6.1.1.1 Unless otherwise specified for particular tests, standard test conditions for the determination of compliance with performance requirements **shall** be one combination of:

(a) An ambient temperature in the range 15 C to 25 C;

(b) A relative humidity in the range 45% to 75%;

(c) An air pressure in the range 86 kPa to 106 kPa; and

(d) The nominal supply voltage of the equipment.

6.1.1.2 Where elements in a test circuit are variable, the test **shall** be carried out over the indicated range for that element.

6.1.1.3 The accuracy for all measurements **shall** be better than ±2% for voltage and current, ±0.25% for frequency and ±0.5% for time, unless otherwise specified.

6.1.1.4 Unless otherwise specified for individual tests, all component values in the test configuration shall have a tolerance of:

(a) ± 1% for resistance;

(b) ±1% for capacitance; and

(c) – 0% + 25% for inductors.

6.1.1.5 The tolerance of the nominal 48 Vd.c. test source **shall** be ±0.5V.

6.1.1.6 The prevailing conditions **shall** be recorded for each test.

6.1.2 Conformance Testing

6.1.2.1 All ISDN CE **shall** undergo conformance testing in accordance with the testing procedures defined in this document before being connected to a ISDN Primary Rate Access interface Telecommunications Network.

6.1.2.2 The conformance testing procedures defined in this standard are based on the general methodology and framework for OSI conformance testing as described in ITU–T Rec. X.290 [74].

6.1.2.3 Wherever possible, the testing procedures have been based on the developing international standards in this field. It is intended that the testing procedures be

fully aligned with the applicable ITU–T Recommendations, once the latter reach an appropriate state of maturity.

6.1.2.4 Suppliers are required to provide the test house with:

(a) System Under Test (SUT);

(b) completed questionnaire (PICS PROFORMA) declaring the features supported by the SUT for which testing is requested; and

(c) completed questionnaire (PIXIT PROFORMA) containing extra information on the implementation of the SUT necessary for the proper conduct of the conformance test, including instructions for test operators, timer values, etc.

6.1.2.5 The outcome of the testing procedures **shall** be a statement issued by the test house indicating the overall conformance or non–conformance of the SUT to the mandatory requirements of this Technical Standard. In addition, the test house may optionally report to the supplier on specific areas of non–conformance in cases where non–conformance was observed.

6.1.3 Protocol Testing

6.1.3.1 The protocol conformance test suites defined in this Standard **shall** be employed to test the response of the SUT to three categories of network protocol behaviour:

(a) Proper Network Behaviour:

protocol elements which are correctly encoded and transmitted to the SUT at the correct time and in the correct sequence;

(b) Improper Network Behaviour:

protocol elements which areincorrectly encoded; and

(c) Inopportune Network Behaviour:

protocol elements which are correctly encoded but which are not transmitted in the correct sequence and at the correct time.

6.1.3.2 The testing procedures verify the response of the SUT to a wide range of proper network behaviour, as defined in the appropriate test suite. In general, the response of the SUT is precisely defined in the protocol specification and/or test suite. This includes the SUT response to 'normal' network failures such as transmission errors and link resets.

6.1.3.3 The testing procedures also verifies the SUT response to a representative range of Improper and Inopportune Network Behaviour in accordance with the applicable part of TS 014. The testing of the CE's response to these Improper and Inopportune Network Behaviour ensures a measure of robustness against network faults and an appropriate CE response in situations where the CE and network equipment are implemented to different versions of the interface specifications.

6.1.3.4 All test procedures defined here involve active test methods and are classified in ITU–T Rec. X.290 [74] terms as ‘external test methods’ and ‘remote test methods’, since they do not require direct access to internal functions of the SUT. Instead, all observation and control is performed at external interfaces of the SUT. Furthermore, no explicit test co–ordination procedures are required to be implemented in the SUT.

6.1.3.5 Some co–ordination between the SUT and the tester may be required to, for example, force the SUT to initiate a call or to respond appropriately to particular types of call setup. These requirements may be expressed, for example, as instructions to the test operator.

6.1.3.6 The conformance test suite **shall** have a hierarchical structure as follows:

(a) Test Suite;

(b) Test Group;

(c) Test Case;

(d) Test Step; and

(e) Test Event

6.1.3.7 An important level is the test case. Each test case has a narrowly defined purpose, such as that of verifying that the IUT has a certain required capability.

6.1.3.8 Test cases are logically grouped together into nested test groups to form the total test suite.

6.1.3.9 Each test case is structured into a series of test steps as follows:

(a) Preamble:

optional test steps to put the IUT into the state required for the test body to start;

(b) Test Body:

one or more test steps to determine the conformance of the IUT to the required capability or behaviour;

(c) Postamble:

optional test steps to return the IUT to a known state at the completion of the test case.

6.1.3.10 A test step consists of an ordering of other test steps and/or test events, each test event representing, for example, the sending or receiving of a single frame or message.

6.1.3.11 The test body results in an observed outcome representing the series of events which occurred during execution of the test case, including all input to and output from the IUT at the points of observation and control. An analysis of results is then performed by comparing the observed outcome with the foreseen outcome for the test case, resulting in one of three verdicts:

(a) Pass:

means that the observed outcome matches one of the outcome identified as 'pass' in the abstract test case specification;

(b) Fail:

means that the observed outcome matches one of the outcomes identified or categorised as 'fail' in the abstract test case specification;

(c) Inconclusive:

means that the observed outcome either matches an outcome identified or categorised as 'inconclusive' in the abstract test case specification, or else does not match any foreseen outcome.

6.1.3.12 The verdicts made in respect of individual test cases are synthesised into an overall summary for the IUT, based on the test cases executed.

6.1.4 Testing of Mandatory and Optional Features

6.1.4.1 Each test specification identifies a number of mandatory and optional features of CE supporting ISDN Primary Rate Access. Separate test procedures are associated with each mandatory and optional feature. At the time of applying for testing, the CE supplier **shall** confirm that all mandatory features are supported and **shall** nominate which optional features are supported. The test house **shall** then execute the defined test procedure relating to each mandatory and supported optional feature.

6.1.4.2 The specification of the test procedures ensure the following:

(a) mandatory and supported optional features initiated by the SUT: all such features are activated during the test procedure, and that these features are correctly implemented by the SUT;

(b) mandatory and supported optional features initiated by the network: the SUT can receive and correctly respond to all such features which can be initiated by the network;

(c) optional features initiated by the SUT declared as unsupported by the SUT: the SUT does not initiate features which are claimed to be unsupported;

(d) optional features initiated by the network declared as unsupported by the SUT: the SUT can receive signalling relating to any network feature not supported by the SUT, and reject this feature in accordance with the protocol

without unduly affecting the operation of other features in effect at the interface.

6.1.4.3 It is expected that CE will generally implement additional customer access interface protocols outside the scope of this Standard, in order to support ISDN bearer services, teleservices and/or supplementary services supported by the network beyond those defined in this Standard. In most situations, these additional protocols will not interact with the testing procedures defined in Clause 6 of this Technical Standard. However, in some situations, the test procedure may need to be varied in the following ways, to take account of the special requirements of the CE:

(a) the Preambles/Postambles for state–based testing may be varied by the tester, provided that the applicable state is reliably entered prior to execution of each test body;

(b) additional information elements beyond the scope of TS 014 (e.g. separately defined within an applicable network Manager's specification) sent by the Implementation Under Test may be ignored by the tester for the purposes of determining compliance with TS 014;

(c) where the Implementation Under Test requires additional information elements beyond the scope of TS 014 (e.g. separately defined in a network Manager's specification) to be sent by the tester in order to successfully test the basic call control procedures, these additional information elements may be added at the discretion of the test house.

6.2 Layer 1

6.2.1 Loss of Input Signal

Under loss of input signal conditions, using a Frame Analyser, check that the alarm bit (bit 3 of time slot 0) is set.

6.2.2 AIS Received

Check that when the input is a continuous binary '1' condition (AIS), the alarm bit on the output is set.

6.2.3 Loss of Frame Alignment

Check that the loss of Frame Alignment causes the alarm bit to be set. Use a Frame Analyser to generate Frame Alignment errors on the input, and monitor the output.

6.2.4 High Bit Error Ratio

6.2.4.1 Check that a high bit error ratio causes the alarm bit to be set. Use a suitable noise source attached to the Primary Rate Interface receive circuit to generate errors at the required ratio.

(a) To set up an error rate which should not cause the alarm, set BER to 0.5 in 10^3.

(b) To set up an error ratio which should cause the alarm, set BER to 1.5 in 10^3.

6.2.4.2 Monitor the output, checking for Bit 3 of Time Slot 0 odd numbered frames set to '1'. Operation or resetting of the alarm should occur within 10 seconds.

Note: Bit error ratios will vary somewhat with any real noise source. Allow some margin for setting/resetting of bit 3 of Time Slot 0 of odd numbered frames activation and deactivation (within reason) given that the nominal BER which justifies the alarm is 1.0 in 10^3.

0.5 in 10^3 corresponds to 623 CRC Errors/1000 Transmission Units if CRC–4 is used.

1.0 in 10^3 corresponds to 831 CRC Errors/1000 Transmission Units if CRC–4 is used.

1.5 in 10^3 corresponds to 902 CRC Errors/1000 Transmission Units if CRC–4 is used.

6.3 Layer 2

6.3.1 General

6.3.1.1 This section defines the layer 2 (L2) conformance tests that **shall** be performed on CE designed for connection to an ISDN Primary Rate service. The protocol is described in Clause 5.3.

6.3.1.2 The protocol can be defined by the two way communication between two separate entities. The L2 entity **shall** be tested for:

(a) Responses to network originated frame types;

(b) Integrity and capability of user initiated frames; and

(c) Those aspects of the protocol specific to the CE, such as timers, counters, and other parameters.

6.3.1.3 The tests to be performed are detailed in test matrices 1 and 2 which are contained in Appendices C and D. Each of these aspects is treated in each of the grouped states representing point–to–point procedures (states 4–8). Test matrix 1 deals with point–to–point procedures, while Test matrix 2 deals with timers and counters.

6.3.2 Testing Strategy

6.3.2.1 Testing Types

This specification uses Proper, Improper, and Inopportune frames to test the CE's Layer 2 entity and the following describes these terms in relation to the layer 2 testing:

(a) Proper:

A proper frame is a syntactically valid frame arriving at the correct sequence in time.

(b) Improper:

An improper frame is one that is syntactically incorrect:

(i) Is not properly bounded by two flags;

(ii) Contains fewer than 40 bits between flags;

(iii) Contains a frame check sequence (FCS) error;

(iv) Contains an invalid address field encoding;

(v) Contains a command or response control field that is undefined or not implemented in Clause 5.3;

(vi) Is an I frame which an information field that exceeds the maximum established frame length;

(vii) Is an un-numbered or supervisory frame with an information field which is not permitted;

(viii) Is a frame with invalid N(R);

(ix) Is an I frame in which the number of bits is not an integral multiple of '8' (not–octet aligned).

(c) Inopportune:

An inopportune frame is defined as a syntactically valid frame which is out of sequence. The IUT is in an incompatible state when this type of frame arrives, and therefore the frame received should be considered irrelevant.

6.3.2.2 Test Numbering

The testing consist of two test groups (i.e. test matrices 1 and 2). Each column represents the states of the L2 entity tested. Each row of a matrix identifies those tests with a common test frame or a common test condition. Every test case is allocated a test number.

The test number is derived from the following sequence:

Test number = test matrix–column–row.

Where:

(i) test matrix = 1 or 2

(ii) column = a 1 digit number representing the state in which the IUT is placed;

(iii) row = a 2 digit number representing the test frame or row of the test matrix, with preceding zeros.

For example test number 1–7–02 represents the 2nd test within state 7 or matrix 1.

6.3.2.3 Test Responses/Format

Each element within the matrix contains the following information:

A: This is the action(s) specified to be taken by the L2 entity, (refer Clauses 6.3.2.3.1 to 6.3.2.3.5).

S: The state which the IUT enters after the action (*indicates return to initial state)

T: The test type (i.e. Proper, Improper, Inopportune).

6.3.2.3.1 Action

The following actions are defined:

(a) DT – Don't transmit anything after processing frame.

(b) IGN – Ignore frame (i.e. Discard the received frame and take no action).

(c) All command/response frames may be valid actions.

6.3.2.3.2 Primitives

Primitives provide the procedural means of invoking and providing a service between adjacent layers. They are included in the tables to specify conceptually how a data link service interacts with the management entity and with other layers. They are not detectable and **shall** be ignored in the testing procedure.

6.3.2.3.3 MEIs

MEI primitives are useful in determining what further action might be taken. A table of MEI codes is included in Clause 5.3, however, note they are not detectable and should be ignored in the testing procedure.

6.3.2.3.4 Comments

Further information is provided in brackets, giving an indication of why certain actions are taken;

(I–QUEUE)

This indicates that the response by the IUT is an I command, if there is an I frame in the information queue.

Note: However, this is not a direct consequence of the incurred test frame.

(RE–TRANSMIT)

This indicates that the responding command is in fact a previously sent I frame that was unacknowledged. This reply is a consequence of the incurred test frame

(SCRAP I–QUEUE)

Discard information frame queue

6.3.2.3.5 Multiple Actions

Often more than one action can be the correct response. Alternative actions are listed sequentially within the matrix element. These alternative actions can either be the result of an unexpected exception condition, else they may be implementation dependent.

6.3.2.4 Test Procedures

The test cases depicted in matrix 1 represent the expected responses from the user side in reply to a network originated test frame, from a known user side state. Each test is structured into a series of test steps consisting of: Preamble, Test Body and Postamble as described in Clause 6.1.

The Preamble and Postamble for the test cases in test matrix 1 can be derived from the state initialisation information in Appendix E. The Test Body consists of sending the frame defined for each test case defined in the matrices, recording the response and checking the user state after the test event. Appendix F can be used for testing the user state for test matrix 1.

Some of these test cases require the user to be in states that aren't readily obtainable and will require manual pre–setting during the preamble. A L3 entity requests a L2 service by issuing the appropriate primitive. For example if the L3 entity require modulo 128 information transfer, it will request this via the DL–ESTABLISH–REQ primitive. The means by which a particular service is invoked is beyond the scope of this document.

6.3.2.5 **States 7–8 Exception Conditions**

States 7 and 8 contain flags for which exception conditions are tracked. These include:

NORMAL:

No exception flags set

ORB:

Own receiver busy condition

PRB:

Peer receiver busy condition

REJ:

Reject exception condition

Therefore under different exception conditions, alternative actions are sometimes specified. For example, the sending of an RNR frame occurs when the ORB condition arises. The alternative actions are listed sequentially within the matrix, along with an associated heading specifying the exception condition.

Note: Due to the amount of test required, the CE's layer 2 entity will not be tested under these exception conditions, however, the responses for these conditions must be included in case the L2–entity enters one of the these conditions independently. For example, the ORB conditions is generated via an internal signal upon the receiver becoming busy. Should this occur during the progress of a test, the action specified under the normal condition might not apply.

6.4 Layer 3

6.4.1 General

6.4.1.1 This section defines the layer 3 (L3) conformance tests that **shall** be performed on terminal equipment (TE) designed for connection to an ISDN Primary Rate service. The protocol is described in Clause 5.4.

6.4.1.2 The TE's L3 entity will be tested for:

(a) Responses to network originated messages;

(b) Integrity of user initiated messages;

(c) Timer values; and

(d) Operation under network emulation.

6.4.1.3 The first 3 aspects of the protocol are covered in a number of test matrices in a state based form. These tests are descibed in Clause 6.4.2 and Appendices G to K.

6.4.1.4 Clause 6.4.3 deals with network emulation tests and ensures that the TE can perform the whole of a selected state path rather than individual transitions.

6.4.1.5 All terminal equipment **shall** comply with the mandatory tests described in test matrices 1–4 (Appendices G to J respectively).

6.4.1.6 The states have been organised into 4 test groups:

(a) Test Matrix 1

(i) Originating call establishment: States 1, 2, 3, 4

(b) Test Matrix 2

(i) Destination call establishment: States 6, 7, 8, 9

(c) Test Matrix 3

(i) Null state: 0

(ii) Active state: 10

(iii) Call clearing: States 11, 12, 19

(d) Test Matrix 4

(i) Timer values.

6.4.1.7 A combination of Proper, Improper, and Inopportune test messages is fired at the IUT in each state. A list of messages to be used is given below. Note that the NOTIFY message is a facility related message, not defined in this Technical Standard. However, it is included as a typical message which may or may not be implemented as a network Manager's option, refer ITU–T Rec. Q.931 [49].

Test Messages

Alerting

Call Proceeding

Connect

Connect Acknowledge

Disconnect

Information

Notify

Progress

Release

Release Complete

Setup

Setup Acknowledge

Status

STATUS ENQUIRY

6.4.2 **State Based Testing**

6.4.2.1 **Test Types**

6.4.2.1.1 This specification uses Proper, Improper and Inopportune messages to test the TE's L3 entity and the following describes these terms in relation to the layer 3 testing:

(a) Proper:

A proper message is a syntactically valid message arriving at the correct sequence in time. This means that the protocol discriminator, call reference and the message type information elements (IE's) are correctly coded and sequenced, plus all additional IEs are syntactically valid and sequentially correct so that they abide by all the requirements of Clauses 5.4.2.2 and 5.4.2.3.

(b) Improper: An improper message is one that is syntactically incorrect:

(i) Protocol discriminator IE corrupted;

(ii) Call reference IE corrupted;

(iii) Message type IE corrupted;

(iv) IE not implemented;

(v) Content Error

– Essential IE;

– Non–essential IE;

(vi) Missing Essential IE.

(c) Inopportune:

An inopportune message is defined as a syntactically valid message which is out of sequence. The IUT is in an incompatible state, however, there may be a predefined response catering for this in the protocol.

Note: A full complement of every possible test message in every possible state is not provided. In certain IUT states, a received improper test message is actually treated as inopportune. Therefore many various improper test cases are essentially repeated versions of the same inopportune test case. This can be attributed to the definition of an error condition by which rules in paragraphs of Clause 5.4.2.4 apply in order of precedence.

6.4.2.2 **Test Numbering**

6.4.2.2.1 The State Based testing consists of 4 test groups (i.e. test matrices F to I). Each column represents the states of the L3 entity tested. Each row of a test matrix identifies those tests with a common test message or test condition. Every test case is allocated a test number.

The test number is derived from the following sequence:

Test number = test matrix – column – row

Where:

(i) test matrix = 1, 2, 3 or 4

(ii) column = a 2 digit number representing the state in which the IUT is placed, with preceding zeros.

(iii) row = a 3 digit number representing the test message or row of the test matrix, with preceding zeros.

(iv) For example Test number 3–02–005 refers to the 5th test within state 2 of test matrix 3.

6.4.2.3 **Test Equipment Setup**

The state based tests outlined in the test matrices contained in appendices G to J require an ISDN compatible protocol analyser to operate as a network simulator as illustrated in Figure 20.

6.4.2.4 **Test Responses/Format**

6.4.2.4.1 Each element within the matrix contains the following information:

(a) A: This is the action(s) specified to be taken by the IUT, such as:

(i) DT – Don't transmit anything after processing the message.

(ii) IGN – Ignore message (i.e. discard the received message and take no action).

(b) S: The state which the IUT enters after the action.

(c) T: The test type (i.e. Proper, Improper, Inopportune).

6.4.2.4.2 Where more than one action is possible, they **shall** be listed sequentially within the matrix element. Multiple actions arise because of the implementation dependent actions. For example, in most cases, receiving an inopportune message results in either:

(a) Sending a STATUS/C=101; or

(b) Sending a STATUS ENQUIRY.

6.4.2.4.3 Similarly multiple actions may arise in the case of voluntary features described in network Manager's specifications. For example an IUT receiving an opportune message with an non–implemented IE has the option of sending a STATUS/C=99 or to ignore the IE.

6.4.2.5 **Test Procedures**

The test cases depicted in matrices 1 to 4 represent the expected responses from the user side in reply to a network originated test message, from a known user side state. Each test is structured into a series of test steps consisting of: Preamble, Test Body and Postamble as defined in Clause 6.1. The Preamble and Postamble are performed using the 'Initialisation Sequences' described in Appendix J. The Test Body consists of sending the message defined for each test case defined in the matrices, recording the response and checking the user state after the test event, using the STATUS ENQUIRY message.

6.4.3 **Network Emulation Tests**

6.4.3.1 **General**

6.4.3.1.1 The aim of this section is to evaluate the ability of the device under test to interwork with a protocol analyser emulating the Australian ISDN network.

6.4.3.1.2 It should be noted that this testing is to ensure that supplier's equipment and the Australian network are able to interwork at the minimum level.

6.4.3.2 **Test Numbering**

6.4.3.2.1 The 4 state based test groups plus emulation tests make up 5 layer 3 test groups. The emulation tests will be test group 5 and are divided into four main test sub–groups, namely:

(a) Sub–Group 01 – Successful call establishment.

(b) Sub–Group 02 – Controlled Error Tests.

6.4.3.2.2 Within each Sub–Group there are a number of test cases defined.

6.4.3.2.3 The test number **shall** consist of:

Test Group – Test Sub–Group – Test Case

Where:

(i) Test Group Number is 5;

(ii) Sub–Group Number is a 2 digit number (see above);

(iii) Test Case Number is a 3 digit number with leading zeros.

6.4.3.3 **Equipment Setup**

6.4.3.3.1 For the Layer 3 Network Emulation tests the testing configuration is detailed in Figure 21.

6.4.3.3.2 The Test Centre **shall** conduct the testing using an appropriate Protocol Analyser for Network Emulation and monitoring.

6.4.3.4 **Supplier's Equipment**

6.4.3.4.1 The SUT **shall** be easily configurable by the Test House to accept any local called party number at the Terminating interface and send any national called party number at the Originating interface.

6.4.3.4.2 The supplier will be required to provide the following equipment:

(a) Unit under test (e.g. PABX); and

(b) Up to 4 terminals (preferably 2 as auto–answer digital terminals).

6.4.3.5 **Equipment Initialisation**

6.4.3.5.1 Prior to commencement of the Emulation tests it is necessary to connect the supplier's equipment to the Network Emulator in a controlled manner and to observe the initialisation activities occurring on the D–Channel. The procedures described below **shall** be followed to connect equipment to the Network Emulator.

(a) Ensure that the NT1 and Network Emulator are powered down.

(b) Ensure that the supplier's equipment is powered down.

(c) Connect the supplier's equipment to the NT1.

(d) Apply power to the Network Emulator and NT1 devices in turn. Monitor and record, on the monitoring analyser, any layer 2 and layer 3 activity.

(e) Apply power to the supplier's equipment. Monitor and record, any layer 2 and layer 3 activity.

(f) The supplier's equipment and the Network Emulator should now automatically establish a data link connection to the multiple frame established state. Do not, at this stage, attempt any calls to or from the

PABX. Leave the system in this state for a period of 10 minutes and monitor and record all layer 2 and layer 3 activity on the interface.

(g) If, at the completion of the 10 minute period, the PRA interface appears stable and the data link has remained in the multiple frame established state, further testing as defined in following sections may be conducted. Retain the record of all D–Channel signalling activity.

6.4.3.6 **Test Cases**

The test cases identified in this section require some form of activity at the terminal instrument connected to the supplier's equipment. These test cases are essentially manually initiated and controlled. The traffic cases tested represent typical calls. In addition, typical call 'failure' conditions, the type of which can reasonably be expected to occur under normal operational conditions, are simulated.

The aim of these test cases is to demonstrate the capability of handling basic calls and to verify that the supplier's equipment is capable of recovering from the more likely fault and call failure conditions.

6.4.3.6.1 **Successful Call Establishment**

6.4.3.6.1.1 **Test No. 5–01–001**

Aim: To verify correct call handling in the establishment and clearance of a call (originated by supplier's equipment, A–party clear).

Procedure:

1. From the supplier's equipment generate a test call with the following attributes:

   a. A valid Called party number.

   b. En–bloc or overlap sending may be used.

1a. Generate test calls with all service types available in the system under test.

   (i) Speech Bearer service

   (ii) 3.1 kHz Audio Bearer service

   (iii) 64 kbit/s Unrestricted Digital service.

2. Return an ALERTING message from the network emulator followed, approximately 30 seconds later, by a CONNECT message.

3a. Verify B–Channel transmission path.

3b. Clear the call from the supplier's equipment terminal approximately 30 seconds after the CONNECT indication has been received.

Verify:

1. SETUP message IE coding (at the originating interface).

2. Supplier equipment has access to network provided Ring tone, for Audio/Speech calls, following transmission of the ALERTING message from the network.

3. Verify B–Channel transmission path.

4. Following clearance of the call ensure a follow–on call is possible from the terminal just used.

5. Correct D–Channel signalling occurs for this case.

6.4.3.6.1.2 **Test No. 5–01–002**

Aim: To verify correct call handling in the establishment and clearance of call (originated by supplier's equipment B–party clear).

Procedure:

1. Repeat the procedure described for test 5–02–001 with the exception that call clearance should be initiated by the network emulator.

Verify:

1. Following clearance of the call ensure a follow–on call is possible from the terminal just used.

2. Correct D–Channel signalling occurs for this case.

6.4.3.6.1.3 **Test No. 5–01–003**

Aim: To verify correct call handling in the establishment and clearance of a call (terminated by supplier's equipment, A–party clear).

Procedure:

1. From the network emulator generate a test call with the following attributes:

   a. Bearer capability appropriate for the service being tested.

   b. A valid Called party number.

2. Allow the terminal to ring for approximately 30 seconds and then answer the call.

3. Allow the call to remain in the active phase and then clear the call from the network emulator.

Verify:

1. Following clearance of the call ensure a follow–on call is possible from the terminal just used.

2. Correct D–Channel signalling occurs for this case.

6.4.3.6.1.4 **Test No. 5–01–004**

Aim: To verify correct call handling in the establishment and clearance of a call (terminated by supplier's equipment B–party clear).

Procedure:

1. Repeat the procedure described for test 5–02–004 with the exception that call clearance should be initiated by the terminal connected to the supplier's.

Verify:

1. Following clearance of the call ensure a follow–on call is possible from the terminal just used.

2. Correct D–Channel signalling occurs for this case.

6.4.3.6.1.5 **Test No. 5–01–005**

Aim: To verify correct call handling when B–Channel negotiation requires a changeover of the nominated channel (originated by supplier's equipment).

> Note: This test need only be executed if the supplier's equipment provides the B–Channel selection indication 'channel is indicated, any alternative is acceptable'.

Procedure:

1. Originate a test call from the supplier's equipment with the following attributes:

   a. A valid Called party number.

   b. En–bloc or overlap sending.

   c. 'channel is indicated, any alternative is acceptable'.

2. Return an ALERTING message from the Network Emulator, indicating an alternative B–Channel, followed, approximately 30 seconds later, by a CONNECT message.

3. Clear the call from the supplier's equipment terminal approximately 30 seconds after the CONNECT indication has been received.

Verify:

1. Supplier's equipment has access to network provided Ring tone, for Audio/Speech calls, following transmission of the ALERTING message from the NETWORK.

2. Correct D–Channel signalling occurs for this case.

3. Verify the B–Channel transmission path.

6.4.3.6.1.6 **Test No. 5–01–006**

Aim: To verify correct call handling when B–Channel negotiation requires a changeover of the nominated channel (call originated by the network).

Note: This test need only be executed if the supplier's equipment requires the use of the B–Channel selection indication 'channel is indicated, any alternative is acceptable'. In addition, the test performance requires the ability to block B–Channels at the supplier's equipment.

Procedure:

1. At the supplier's equipment ensure that only one B–Channel is available for incoming calls by blocking all but one B–Channel.

2. Originate a test call from the network emulator to a terminal connected to the supplier's equipment requesting one of the blocked B–Channels.

3. It is not necessary to answer the call.

Verify:

1. Verify that B–Channel changeover has occurred.

2. Correct D–Channel signalling occurs for this case.

6.4.3.6.2 **Controlled Error Testing**

This section applies tests to verify the ability of supplier's equipment to recover from various error conditions. In particular three conditions are tested:

(a) Data link reset;

(b) Data link failure; and

(c) Power down of user equipment.

6.4.3.6.2.1 **Test No. 5–02–001**

Aim: To verify correct supplier's equipment response to a data link reset condition.

Procedure:

1. Establish a test configuration as before with a Frame Analyser across the S/T interface.

2. Ensure that the network emulator setting for the Layer 2 parameters N200 and T200 are 3 and 1 second respectively.

3. Establish the following call types:

   a. Call originated by network emulator terminated by CE. Call in active state.

   b. Call originated by CE (Call in overlap sending state).

4. Using the Frame Analyser insert the AIS signal (all ones condition) into timeslot 16 (D–Channel), in the direction NT1 to supplier's equipment, for a period greater than 3 seconds but less than 6 seconds.

5. Record all Layer 2 and Layer 3 activity on the monitor.

Verify:

1. That a data link reset has occurred.

2. The calls in the overlap sending state are cleared by the network sending DISCONNECT messages.

3. All other calls are unaffected.

4. The supplier's equipment responds correctly to the STATUS ENQUIRY messages sent by the Network emulator for the unaffected calls.

6.4.3.6.2.2 **Test No. 5–02–002**

Aim: To verify correct supplier's equipment response to a data link failure condition (failure persists for a period shorter than T309).

Procedure:

1. Repeat steps 1–3 of Test 5–01–001.

2. Verify that T309 is set for 15 seconds in both the network emulator and the supplier's equipment (if implemented).

3. Repeat step 4 of Test 5–02–001 but for a period greater than 6 seconds but less than 15 seconds.

4. Record all Layer 2 and Layer 3 activity on the monitor.

Verify:

1. That a data link failure has occurred.

2. That calls in the overlap sending state are internally cleared.

3. All other calls are unaffected.

4. Data link re–establishment occurs automatically (initiated by the network).

5. The supplier's equipment responds correctly to the STATUS ENQUIRY messages sent by the network for all other calls.

6.4.3.6.2.3 **Test No. 5–02–003**

Aim: To verify correct exchange and supplier's equipment response to a data link failure condition (failure persists for a period greater than T309).

Procedure:

1. Repeat steps 1–3 of Test 5–02–001.

2. Verify that T309 is set for 15 seconds in both the network and the supplier's equipment (if implemented).

3. Repeat step 4 of Test 5–02–001 but for a period greater than 15 seconds but less than 60 seconds.

4. Record all Layer 2 and Layer 3 activity on the monitor.

Verify:

1. That a data link failure has occurred.

2. That calls in the overlap sending state are internally cleared.

3. All other calls are internally cleared by the network and possibly the NT2 if it implements T309.

4. Data link re–establishment occurs automatically (initiated by the network).

6.4.3.6.2.4 **Test No. 5–02–004**

Aim: To verify the NT2 recovery when the NT1 equipment is powered down with calls in the Active State.

Procedure:

1. Set up 2 calls from the network emulator to the SUT.

2. Power down the NT1.

3. Wait 2 minutes and then power up the NT1.

4. Send a STATUS ENQUIRY message to the SUT for each of the above calls

5. Set up 2 new calls from the network emulator to the SUT, using the same 2 call references as used in step 1. above.

Verify:

1. Verify that the response to the STATUS ENQUIRY indicates the SUT is in the Null state.

2. Both calls in step 5, above are successful.

6.4.3.6.2.5 **Test No. 5–02–005**

Aim: To verify the NT2 recovery when the NT2 equipment is powered down with calls in the Active State.

Procedure:

1. Set up 2 calls from the network emulator to the SUT.

2. Power down the NT2.

3. Wait 2 minutes and then power up the NT2.

4. Send a STATUS ENQUIRY message to the SUT for each of the above calls

5. Set up 2 new calls from the network emulator to the SUT, using the same 2 call references as used in step 1 above.

Verify:

1. Verify that the response to the STATUS ENQUIRY indicates the SUT is in the Null state for each call.

2. Both calls in step 5, above are successful.

6.4.3.6.3 Legend for Test Matrices 1–3

i. If the matrix indicates a response with cause # 97 or # 101 then the same response with cause # 98 **shall** be treated as a valid response.

ii. If the matrix indicates a response with cause # 95 then the same response with cause # 100 **shall** be treated as a valid response.

iii. If the matrix indicates a response with cause # 30 then the same response with cause # 97 or # 98 **shall** be treated as a valid response.

iv. Note 1: means: The treatment of a DISCONNECT message in state 1 as 'inopportune' is implementation dependent.

v Note 2: means: The protocol allows an optional STATUS/C=99,S=XX to be sent here, where XX refers to the user state after the current transition.

vi. STATUS/C= ,S=4(3) means: A STATUS message indicating any cause and either state 4 or 3 **shall** be treated as a valid response.

vii. REL means: A RELEASE with any cause or no cause will be treated as a valid response.

viii. – means: No test required – covered by other tests.

ix. / means: No test required – covered by other tests. (Call reference error. Call clearing should be initiated by transmission of RELease message with C=81. An additional STATUS message may optionally be returned, with a cause value identifying the embedded error.)

x. // means: As for ix above except cause could be # 81 or # 101

xi. NA means: Test not applicable in this user state.

xii. Tests specifying 'Non–implemented IE' **shall not** use an IE for which 'Comprehension Required' coding is used.

xiii. Testing in state 9 is optional unless the SUT may send a CALL PROCEEDING, in which case the test is mandatory.

xiv. A response time of 3.5 seconds **shall** be allowed for each test, with the following exceptions:
  (a) All tests in states 8 or 19 **shall** allow 2 seconds for responses.
  (b) All tests for which the test is 'No Action', **shall** allow 10 seconds for responses.

xv. A STATUS ENQUIRY is valid in all states.

xvi. Note 3: means: Procedures are contradictory. Either response **shall** be accepted. However, DT is preferred.

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7 COMPLIANCE WITH INTERNATIONAL STANDARDS

7.1 Layer 1

7.1.1 Configuration

As described in ITU–T Rec. I.411 [33] and I.431 [35], with a little more detail showing the exchange end of the transmission line.

7.1.2 Power Feeding

ITU–T Rec. I.431 [35], states that Power Feeding is optional. This option is not selected.

7.1.3 Channel Functions

From ITU–T Rec. I.431 [35], Section 3.1, except H channels are not included. Bit, octet and frame timing are in accordance with ITU–T Rec. I.431 [35] Section 5. B and D channels are nominated specifically as in ITU–T Rec. I.431 [35].

7.1.4 Timing Functions

Timing Functions and Frame alignment are in accordance with ITU–T Rec. I.431 [35].

7.1.5 Bit Rate

The Bit Rate is in accordance with ITU–T Rec. G.703 [19].

7.1.6 Coding

The Line Coding scheme utilised is HDB3 and is in accordance with ITU–T Rec. G.703 [19], Annex A.

7.1.7 Framing

Framing is in accordance with ITU–T Rec. I.431 [35] which calls up ITU–T Rec. G.704 [20]. All S_a bits are set to 1. B–Channels and D–Channels are assigned in accordance with ITU–T Rec. I.431 [35]. Frame alignment is in accordance with ITU–T Recs. G.706 [21] and I.431 [35]. Time Slot (TS) 16 is used for D channel (common) signalling in accordance with ITU–T Rec. G.704 [20].

7.1.8 **Output Signal Characteristics**

The Pulse shape is as specified in ITU–T Rec. I.431 [35] which refers to ITU–T Rec. G.703 [19]. The impedance selected from the two alternatives given is 120 • balanced (symmetric) pair.

In order to reduce matching problems at output ports, the pulse shape should also be checked with an additional parallel load of 160 µH.

7.1.9 **Input Signal Characteristics**

As specified in ITU–T Rec. G.703 [19]. ACA Technical Standard 008 [3] is referred to as a description of a standard screened pair cable. Return loss is in accordance with ITU–T Rec. G.703 [19].

In order to reduce matching problems at input ports, the pulse shape should also be checked when driven from a port with 160 µH inductance in parallel.

Jitter and Wander is specified differently from the ITU–T Rec. I.431 [35] specification, as a higher tolerance to jitter is required at frequencies below 3.6 kHz for the existing 2048 kHz network equipment. The relevant specification is taken from ITU–T Rec. G.823 [28] Table 2.

Jitter measurements are specified as being made with a pseudo–random binary sequence as described in ITU–T Rec. O.151 [44] and using test apparatus as described in ITU–T Rec. O.171 [45].

7.1.10 **Operations and Maintenance**

AIS is as defined in ITU–T Rec. G.704 [20]. The use of E–bits is as defined in ITU–T Rec. G.704 [20].

CRC Multiframe alignment is as described in ITU–T Rec. G.706 [21]. Processing in the transmission link is in accordance with ITU–T Rec. I.431 [35].

Alarm Bits (RAI): The use of RAI (Remote Alarm Indication) follows the use given in ITU–T Rec. I.431 [35], except that an additional cause for use is included. As well as loss of signal, loss of frame alignment, and reception of AIS, the reception of an error rate as high as 1 in 10^3 for a period as long as n seconds is added. The value of n is set at 10 for the customer equipment (CE), and set at a value from 5 to 60 for the network equipment. This usage allows alerting of maintenance staff if a marginal service error rate condition arises.

National Information Bits: ITU–T Rec. G.704 [20] allows the S_4 and S_8 bits to be used for international purposes. However, no specific purpose has yet been assigned to these bits. Technical Standard 014 states that all these bits are not used and are to be set to 1 in both directions.

Idle Codes: The B–Channel idle code in both directions is consistent with the rules given in ITU–T Rec. I.431 [35]. The NT2–to–NT1 direction code is consistent with

Basic Access, where the default idle code is naturally all '1's in a B–Channel.

7.2 Layer 2

7.2.1 General

7.2.1.1 The LAPD protocol for ISDN primary rate access as specified in this standard is based on and retains the structure of the revised ITU–T LAPD standard ITU–T ITU–T Recs. Q.920 [46] and Q.921 [47]. All sections of ITU–T ITU–T Recs. Q.920 [46] and Q.921 [47] which differ from this technical standard are identified. Under each section heading there is a statement as to whether the whole section is not applicable or only part of the section is applicable. If the section is partially applicable, the differences are detailed. Any sections of ITU–T ITU–T Recs. Q.920 [46] and Q.921 [47] not listed are fully applicable to this LAPD standard.

7.2.1.2 The main functions which are not applicable to this Technical Standard may be summarised as follows:

(a) broadcast information transfer;

(b) unacknowledged operation;

(c) TEI administration; and

(d) automatic negotiation of data link layer parameters.

Layer 2 – Primary Rate Departures

ITU–T Rec. Q.920 [46] Clause No.		Departure of TS 014 from ITU–T Q.920 [46]
7.3.3.1	General	Information transfer is via point–to–point data links only. Broadcast information transfer is not applicable. Figure 6/Q.920 [46]: only example (a) is applicable as the standard supports SAPI = 0 only and the CE side is NT2. Figure 7/Q.920 [46] is not applicable.
7.3.3.2	Unacknowledged operation	This whole section is not applicable.
7.3.3.4.1	Data link connection identification	The TEI management procedures are not supported in this standard. This standard supports only point–to–point information transfer for SAPI = 0, hence Figure 8/Q.920 [46] has been heavily edited to exclude broadcast information transfer and SAPI = 16.
7.3.3.4.2	Data link states	The TEI–unassigned state is not applicable since the NT2 is pre–assigned a TEI value of 0. Broadcast information transfer is not applicable.
7.3.3.4.3	TEI administration	This whole section is not applicable.
7.3.4.2	Services provided to layer 3	Only multiple frame acknowledged operations transfer service is supported in the standard. Unacknowledged information transfer is not applicable. The data link layer also provides administrative services for layer 3 in order to implement information transfer services.
7.3.4.2.1	Unacknowledged information transfer service	This whole section is not applicable. The DL–UNIT DATA–REQUEST/INDICATION primitives are not supported.
7.3.4.3	Services provided to layer management	This whole section is not applicable.
7.3.4.4	Administrative services	The assignment, checking and removal of TEI values is not supported. The data link connection parameter passing (automatic negotiation of parameters) is not supported. The primitives associated with the assignment of TEI value (MDL–ASSIGN REQUEST/INDICATION), the removal of TEI value (MDL–REMOVE REQUEST) the management data transfer (MDL–UNIT–DATA REQUEST/INDICATION) are not supported.

Layer 2 – Primary Rate Departures (cont.)

ITU–T Rec. Q.920 [46] Clause		Departure of TS 014 from ITU–T Q.920 [46]
7.3.4.5	Model of the Data Link Service	Broadcast data link connections and unacknowledged transfer of information are not applicable. Table 1/Q.920 [46] broadcast information transfer mode, unacknowledged information transfer mode and DL–UNIT DATA primitive are not applicable.
7.3.4.5.2.2	Broadcast data link layer connection services	The whole section is not applicable.
7.3.4.5.2.4	Sequences of primitives at one point–to–point data link connection endpoint	Figure 9/Q.920 [46]: DL–UNIT DATA REQ./IND. primitive is not applicable.
7.3.4.6	Services required from the physical layer	The interface for the primary rate CE–network interface will be active at all times. No activation/deactivation procedures will be applied. Hence the primitives related to the activation/deactivation of the physical layer connection (PH–ACTIVATE–REQ./IND. and PH–DEACTIVATE–IND) are not applicable.
7.3.5	Data Link Layer – Management Structure	TEI assignment, TEI check and TEI removal functions are not applicable.
7.3.5.3	Structure of the data link procedure	Fig. 11/Q.920 [46]: the functional block for broadcast link is not supported. Only SAPI = 0 is supported.
ITU–T Rec.Q. 921 [47] (I.441 [37]) Clause		**Departure of TS 014 from ITU–T Q.921 [47]**
7.3.2.3	Address field	LAPB is not supported in ACA Technical Standard 014.
7.3.2.9	Invalid frames	A frame containing a SAPI which is not supported by the receiver is not an invalid frame.
7.3.2.11	Interframe Timefill	A bit pattern of contiguous octets corresponding to the HDLC flag sequence (01111110) is transmitted on the D–Channel when layer 2 has no frames to send.
7.3.3.3.3	Service access point identifier (SAPI)	Only the SAPI value of 0 related to call control procedures is supported, all other SAPIs are reserved.
7.3.3.3.4	Terminal endpoint identifier (TEI)	A TE may not contain more than one TEI. The TEI for broadcast data link connection is not used in ACA Technical Standard 014.
7.3.3.3.4.1	TEI for broadcast data link connection	This section is not applicable.
7.3.3.3.4.2	TEI for point–to–point data link connection	The only non–automatic TEI supported is 0. No automatic TEIs are supported.

Layer 2 – Primary Rate Departures (cont.)

ITU–T Rec. Q. 921 [47] (I.441 [37]) Clause		Departure of TS 014 from ITU–T Rec. Q.921 [47]
7.3.3.4.3	Unnumbered format (U)	Use for unacknowledged information transfer is not applicable.
7.3.3.5.3	Unacknowledged operation variables and parameters	This section is not applicable.
ITU–T Rec. Q.921 [47] Clause		**Departure of TS 014 from ITU–T Rec. Q.921 [47]**
7.3.3.6	Commands and responses	In Table 5/Q.921 [47], the UI Command and XID Command/Response frames are not applicable. 'Frame types associated with an application not implemented **shall** be discarded and no action **shall** be taken as a result of that frame' is not applicable. Only Modulo 128 multiple frame acknowledged operation is supported.
7.3.3.6.5	Unnumbered information (UI) command	This whole section is not applicable.
7.3.3.6.7	Reject (REJ) command/response	The optional procedure for the retransmission of a REJ response frame described in Appendix I of ITU–T Rec. Q.921 [47] is not applicable.
7.3.3.6.11	Frame reject (FRMR) response	The receipt of a frame with an information field which is not permitted is also a reason for the FRMR response.
7.3.3.6.12	Exchange Identification (XID)	This whole section is not applicable.
7.3.4.1.1	Generic Names	In table 4/Q.921 [47], the following primitives are not applicable: DL–UNIT DATA MDL–ASSIGN MDL–REMOVE MDL–UNIT DATA MDL–XID PH–ACTIVATE PH–DEACTIVATE MPH–ACTIVATE MPH–DEACTIVATE MPH–INFORMATION
7.3.4.1.1.4	DL–UNIT DATA	This section is not applicable.
7.3.4.1.1.5	MDL–ASSIGN	This section is not applicable.

Layer 2 – Primary Rate Departures (cont.)

ITU–T Rec. Q.921 [47] Clause	Departure of TS 014 from ITU–T Rec. Q.921 [47]
7.3.4.1.1.6 MDL–REMOVE	This section is not applicable.
7.3.4.1.1.8 MDL–UNIT DATA	This section is not applicable.
7.3.4.1.1.9 MDL–IXD	This section is not applicable.
7.3.4.1.1.11 PH–ACTIVATE	This section is not applicable.
7.3.4.1.1.12 PH–DEACTIVATE	This section is not applicable.
7.3.4.1.1.13 MPH–ACTIVATE	This section is not applicable.
7.3.4.1.1.15 MPH–INFORMATION	This section is not applicable.
7.3.4.1.3.1 Priority indicator	In this standard, since only one SAP will exist, no contention will exist.
7.3.4.1.3.2 Message unit	In the Note, the DL–UNIT DATA primitive is not applicable.
7.3.4.2.2 Layer 3 – Data Link Layer Interactions	Broadcast data link operation is not applicable. In Figure 8/Q.921 [47], the DL–UNIT DATA–REQ./IND. primitives are not applicable.
7.3.5 Definition of peer–to–peer procedures of the data link layer	Paragraphs (a) and (c) are not applicable.
7.3.5.1.1 Unacknowledged Information transfer	This section is not applicable.
7.3.5.2 Procedures for unacknowledged information transfer	This whole section is not applicable.
7.3.5.3 Terminal Endpoint Identifier (TEI) Management Procedures	This whole section is not applicable.
7.3.5.4 Automatic negotiation of data link layer parameters	The automatic negotiation of data link layer parameters procedures is not supported on the network side.
7.3.5.5.1.2 Establishment procedures	Timer T203 is supported.
7.3.5.5.2 Information transfer	The last paragraph of the section is not applicable as UI frame is not supported.
7.3.5.5.3.1 General	The last paragraph 'In the case of persistent deactivation . . . DL–RELEASE–INDICATION primitive.' is not applicable.

Layer 2 – Primary Rate Departures (cont.)

ITU–T Rec. Q.921 [47] Clause		Departure of ACA TS 014 from ITU–T Rec. Q.921 [47]
7.3.5.5.4	TEI–assigned state	The fourth hyphenated item is not applicable as UI is not supported.
7.3.5.6.5	Receiving RNR frames	With respect to 'If a supervisory command . . .': Expiry of timer T200 does not initiate transmission or retransmission of I frames; the enquiry of the peer status shall 'be repeated' following the expiry of timer T200, or after expiry of timer T200 following the receipt of the RNR response with the F bit set to 1.
7.3.5.8	Exception condition reporting and recover	The actions to be taken by the connection management entity on receipt of an MDL–ERROR–INDICATION primitive are not defined.
7.3.5.8.1	N(S) sequence error	The last paragraph of the section is not applicable.
7.3.5.8.7	Unsolicited response frame	'The data link layer entity **shall** assume possible multiple TEI assignment on receipt of an unsolicited UA response and **shall** inform layer management' is not applicable.
7.3.5.8.8	Double assignment of a TEI value	This whole section is not applicable.
7.3.5.9	List of system parameters	The method of assigning these parameters is not applicable since automatic negotiation of data link layer parameters procedure is not supported on the network side.
7.3.5.9.1	Timer T200	Note 2 is not applicable.
7.3.5.9.3	Maximum number of octets in an information field (N201)	The second hyphenated item is not applicable.
7.3.5.9.4	Maximum number of transmission of the TEI Identity Request Message (N202)	This section is not applicable.
7.3.5.9.5	Maximum number of outstanding I frames (k)	The first, third and fourth hyphenated items are not applicable.
7.3.5.9.6	Timer T201	This section is not applicable.
7.3.5.9.7	Timer T202	This section is not applicable.
7.3.5.10.1	General	The data link layer monitor function is supported for the network side of the link, the use of this function on the CE side is optional.

Layer 2 – Primary Rate Departures (cont.)

ITU–T Rec. Q.921 [47] Clause		Departure of TS 014 from ITU–T Rec. Q.921 [47]
Annex B	SDL for point–to–point procedures	
B.2	An overview of the states of the point–to–point data link layer entity	In figure B–2/Q.921 [47], TEI Unassigned state, Assign Awaiting TEI state and Establish Awaiting TEI state are not applicable, since the NT is pre–assigned a TEI value of 0. Expiry of timer T203 in the Multiple frame established state (state 7) initiates transition to the Timer recovery state (state 8).
B.4	The use of queues	UI frame transmission and UI frame queued up is not applicable.
B.5	SDL representation	The following figures are not applicable: Figure B–3/Q.921 [47] (1, 2 and 3 of 3) Figure B–9/Q.921 [47] (1 of 5) Figure B–4/Q.921 [47] (1 and 2 of 2): With respect to reception of SABME signal, timer T200 is stopped after generating a DL–ESTABLISH–INDICATION. Figure B–5/Q.921 [47] (1,2 and 3 of 3): Reception of MDL–REMOVE–REQUEST and PERSISTENT DEACTIVATION are not applicable;– with respect to DL–RELEASE–REQUEST and DL–DATA–REQUEST SIGNALS, these are not restricted to the layer 2 initiated re–establishment. Figure B–6/Q.921 [47] (1 and 2 of 2): Reception of MDL–REMOVE–REQUEST and PERSISTENT DEACTIVATION are not applicable. Figure B–7/Q.921 [47] (1 and 10 of 10): Reception of MDL–REMOVE–REQUEST and PERSISTENT DEACTIVATION are not applicable. Figure B–8/Q.921 [47] (1–9 of 9): Reception of MDL–REMOVE–REQUEST and PERSISTENT DEACTIVATION are not applicable.
Annex C SDL representation of the broadcast procedures		This Annex is not applicable.
Annex D State transition tables for point–to–point procedures for the data link layer		This Annex is not specified in ACA Technical Standard 014.

Layer 2 – Primary Rate Departures (cont.)

ITU–T Rec. Q.921 [47] Clause	Departure of TS 014 from ITU–T Rec. Q.921 [47]
Appendix I Retransmission of REJ response frames	This Appendix is not applicable.
Appendix II Occurrence of MDL–ERROR–INDICATION within the basic states and actions to be taken by the management entity	Section II.2 – Layout of Table II.1/Q.921 [47] and Section II.3 – Preferred management actions are not applicable. In Table II.1/Q.921 [47] error type D corresponds to F = 0 (F = 1 is a printing error in the Blue Book) error type K: the affected states are 4,5,6,7 and 8; error type N corresponds to receipt of a supervisory or unnumbered frame with incorrect length
Appendix III Optional basic access deactivation procedures	This Appendix is not applicable.
Appendix IV Automatic negotiation of data link layer parameters	This Appendix is not applicable.

7.3 Layer 3

7.3.1 Scope

7.3.1.1 This section provides a comparison of the layer 3 procedures defined in Clause 5.4.2 and ITU–T Rec. Q.931 [49]. It includes references, a brief description of the departures from the ITU–T Rec. Q.931 [49] procedures, and some comments on any implications for the compatibility of Q.931 [49] CE connected to the Australian ISDN network. It also contains a code giving the general nature and impact of the differences according to the legend below.

Legend for coding of departures:

E	=	Editorial change.
A	=	Addition.
D	=	Deletion.
M	=	Modification.

7.3.1.2 The term 'not supported' is used extensively in this comparison. However in some cases it may be supported as a Network option.

Layer 3 – Primary Rate Departures

ITU–T Rec. Q.931 Reference	ACA TS 014 Clause	CODE	Departure of ACA TS 014 from ITU–T Rec. Q.931 [49]
3.1.1, 3.1.2	5.4.2.2.3.1, 5.4.2.2.3.2, 5.4.2.2.3.3	D	Ch.Id mandatory in first response message to SETUP ITU–T Rec. Q.931 [49] allows Ch.Id to be omitted if the channel allocation by the network is accepted by the CE (ie, at the called interface only).
3.1X	3.2.X	D	'Stimulus' information elements for supplementary service control not supported: Signal, Switch–hook, Feature Activation, Feature Indication.
3.1.16	5.4.2.2.3.12	D	IEs for indication of packet–mode parameters not supported: information rate, end–to–end transit delay, transit delay selection/indication packet layer parameters.
3.2	–	D	Messages for Packet mode access connection control – not supported
3.3	–	D	Messages for CE–to–CE associated with circuit switched calls – not supported.
3.4	5.4.2.2.3.14	D	TS 014 does not allow STATUS messages to contain the global call reference. Network will ignore STATUS messages with the global call reference.
4.3	5.4.2.3.3	D	Call Reference value restricted to 2 octets only. Network option in ITU–T Rec. Q.931 [49] if one or two octet CR value not supported. Messages containing CR value of incorrect length will be ignored.
4.3	5.4.2.3.3	D	'Dummy' call reference value not supported (Only required in ITU–T Rec. Q.931 [49] for 'stimulus' mode operation).
4.5.1	5.4.2.3.5.1	D	ITU–T Rec. Q.931 [49] reserves 'reserved' IE identifiers of the form 0000XXXX for future 'comprehension required' IEs.
4.5.1	5.4.2.3.5.1	M D	ITU–T Rec. Q.931 [49] defines a IE identifier code point as 'escape for extension' for codesets 5, 6 and 7. TS 014 reserves this codepoint. Repeat IE supported for cause IE only.
4.5.4	–	D	Non–locking shift not supported.
5.8.5.1	–	D	TS 014 requires IEs to be included in strict numerical sequence. ITU–T Rec. Q.931 [49] allows unsequenced IEs to be accepted as a network option.
4.5.8	5.4.2.3.5.4	D	Various Type of number code points not included.
4.5.8	5.4.2.3.5.4	D	Various Numbering Plan identification code points not included.
4.5.10	5.4.2.3.5.6	D	Network will ignore the presentation indicator in the Calling Party Number IE. ITU–T Rec. Q.931 [49] requires that this field control forwarding of CLI for presentation.
4.5.12	5.4.2.3.5.8	D	Various ITU–T Rec. Q.931 [49] Location code points not supported by the network. CE–generated causes may indicate other values–passed transparently by the network

Layer 3 – Primary Rate Departures (Cont.)

ITU–T Rec. Q.931 Reference	ACA TS 014 Clause	CODE	Departure of ACA TS 014 from ITU–T Rec. Q.931 [49]
4.5.12	5.4.2.3.5.8	M	Location field in Cause IE is 3 bits (ITU–T Rec. Q.931 [49] assigns 4 bits).
4.5.12	5.4.2.3.5.8	D M D	Various Q.931 cause codes not assigned. Full range of ITU–T Rec. Q.931 [49] cause diagnostics not supported. (Q.931 [49] allows diagnostics up o 27 octets in length). Code points for 'X.21' and 'X.25' not included in recommendation field.
4.5.13	5.4.2.3.5.9	M	Octet 5, bit 8, of Channel Id set to '0' (Q.931 [49] requires '1')
4.5.13	5.4.2.3.5.9	D	Explicit interface identification not supported.
4.5.13	5.4.2.3.5.9	D	Slot map method of channel identification
4.5.13	5.4.2.3.5.9	M	Channel number assignment to timeslots differs between ACA TS 014 and ITU–T Rec. Q.931 [49], despite the fact the 'ITU–T Standard' encoding is indicated.
4.5.13	5.4.2.3.5.9	D	Repeated Channel ID IEs not permitted.
4.5.20	–	D	Network–specific facilities IE not supported.
4.5.22	5.4.2.3.5.3	E	Applies during 'establishment' rather than the 'life' of the call. However usage described elsewhere is consistent with ITU–T Rec. Q.931 [49]
4.5.22	5.4.2.3.5.13	M	Location field in Progress indicator is 3 bits (ITU–T Rec. Q.931 [49] assigns 4 bits)
4.5.22	5.4.2.3.5.13	D	Progress indicator codepoint 4 'call has returned to the ISDN' is not assigned.
4.5.23	–	D	Repeat indicator IE not supported.
4.5.24	5.4.2.3.5.14	D	Restart indicator: Class codepoint for 'single interface' not assigned.
4.5.25	–	D	Segmented message IE not supported.
4.5.26	–	D	Sending complete IE not supported.
4.5.27	–	D	Signal IE not supported.
4.5.28	–	D	Transit network selection IE not supported.
4.6	–	D	Supplementary services IEs not defined.
4.7	–	D	Packet communications IEs not defined.
5	5.4.2.4	E	SDL is prime source not the text.
5.1.2	5.4.2.4.1.2	M	CALL PROC messages sent by the network always include channel ID (Even if a SETUP ACK has been sent)
5.1.2	5.4.2.4.1.2	A	If the B–Channel indicated by the network is unacceptable to the CE, the CE clears with cause # 6, 'channel unacceptable'. ITU–T Rec. Q.931 [49]: Not specified.
5.1.3	5.4.2.4.1.3	D	Network does not include progress indicator # 8 in SETUP ACK messages.
5.1.3	5.4.2.4.1.3	D	Network does not accept called party number digits in keypad facility IE – must be in called party.

Layer 3 – Primary Rate Departures (Cont.)

ITU–T Rec. Q.931 Reference	ACA TS 014 Clause	CODE	Departure of ACA TS 014 from ITU–T Rec. Q.931 [49]
5.1.3	5.4.2.4.1.3	D	Sending complete indication not supported. A '# ' will be treated as an IE content error and the call will be cleared. A sending complete IE will be treated as an non–implemented IE and call establishment will proceed.
5.1.5.2	5.4.2.4.1.5.2	D,E	Q.931 [49] specifies cause # 102 to be used if the network clears when T302 expires.
5.1.6	5.4.2.4.1.6	D	Q.931 [49]: Notification of interworking in PROGRESS message causes any supervisory timers to be stopped.
5.1.10	–	D	Transit network selection not supported.
5.2.2	5.4.2.4.2.2	D	Q.931 [49] defines what compatibility checking is required (in Annex B).
5.2.3.1	5.4.2.4.2.3	M	Destination B–Channel selection: network always offers calls with 'Channel is indicated, any alternative is acceptable'
5.2.3.1	5.4.2.4.2.3	M	CE must include channel ID in first message in response to a SETUP. Q.931 [49]: CE may omit channel ID if it accepts the B channel nominated by the network. Call will be cleared in Channel ID is not included in the first message in response to SETUP
5.2.4	5.4.2.4.2.4	D	Overlap Receiving procedures not supported – SETUP ACK in the CE to network direction is treated an invalid message. All available called party number information will be included by the network in the incoming SETUP message. If the CE responds with SETUP ACK then the call will proceed but a STATUS message will be returned. (Note that Network timer T303 (4 sec) will still be running).
5.2.4	5.4.2.4.2.4	D	Explicit 'sending complete' indication not sent by the network.
5.2.4.5	5.4.2.4.2.5.3	E	Q.931 [49] defines call clearing procedures on expiration of the alerting supervision timer. Procedure implicit in TS 014 as this timer is a call handling function.
5.2.6	5.4.2.4.2.5.1	E	Q.931 [49] specified the progress indicators which apply
5.2.5.3 5.2.7 5.3.3 5.3.4	5.4.2.4.2.5.3 5.4.2.4.2.7 5.4.2.4.3.3 5.4.2.4.3.4	D	Q.931 [49] cause code # 102 'recovery on timer expiry' not utilised for clearing on timeout of T301, T310, T308. Some other differences in cause code usage.
5.3.3	5.4.2.4.3.3	D D	Q.931 [49]: On expiry of T305, the CE may include another cause (# 102) in the RELEASE MESSAGE. A different cause is included in the RELEASE sent after T308 expires for the first time.
5.3.4.3	5.4.2.4.4.4(c)	E	ACA TS 014 specified cause # 111 to be used on first expiry of T308. Q.931 [49]: no cause specified.
5.3.4.1	5.4.2.4.4.2	E	Q.931 [49] describes the complete call clearing sequence.
5.4	5.4.2.4.4.1	E	TS 014 specifies the conditions affecting the sending of dial tone

Layer 3 – Primary Rate Departures (Cont.)

ITU–T Rec. Q.931 Reference	ACA TS 014 Clause	CODE	Departure of ACA TS 014 from ITU–T Rec. Q.931 [49]
		E	TS 014 allows either progress indicator # 1 or # 8 to be used. Q.931 [49] allows only # 8.
–	5.4.2.4.5.3	A	Restart collision procedure not specified in Q.931 [49].
5.8	5.4.2.4.8	M	STATUS message indicates the state being entered, rather than the previous state. As a consequence, a STATUS message will follow any immediate response messages associated the transition. (Q.931 [49 not totally clear but with implication that previous state sent in STATUS).
5.8.3.2f	5.4.2.4.8.4.2 (a)	M	STATUS not sent if invalid message received with global CR, (ignored by the network).
5.8.3.2a,g	5.4.2.4.8.4.2 (b)	M	Receipt of a STATUS message in the null state is defined as call reference procedural error.
5.8.3.2a	–	D	Option of sending REL is implemented (Q.931 [49]: alternative procedure is to send REL COM).
5.8.3.2e	–	M	Q.931 [49]: unexpected SETUP messages are ignored TS 014: STATUS message sent.
5.8.3.2g	5.4.2.5.8.4.2 (b)	E	Cause # 81 sent (rather than # 101 as indicated in Q.931 [49]).
–	5.4.2.4.8.4.1	A	Message Type Format Error procedure not in Q.931 [49] (only applies to National messages).
5.8.4	5.4.2.4.8.4.2	D	Specified STATUS (cause # 97) to be sent (Q.931 [49] allows either STATUS or STAT ENQ with either cause # 97 or # 98). CE may send either Cause # 97 or # 98. Recommended that CE send STATUS rather than STATUS ENQ.
5.8.4	5.4.2.4.8.4.3	D E M	Requires STATUS (Cause # 101) to be sent (Q.931 [49] allows either STATUS or STATUS ENQ, with either cause # 98 OR # 101). On receipt of unexpected REL, REL COMP sent with unspecified cause (Q.931 [49] specifies cause in received REL or else # 31). On receipt of unexpected REL COM a STATUS (cause # 101) message is sent (Q.931 [49] specifies immediate return to Null state without notification).
5.8.5	–	D	Errors in non–codeset O IEs not applicable.
5.8.5.2	– –	E E	Procedure specified in Q.931 [49] for action on receipt of out of sequence IEs. Action on receipt of non–permitted duplicate mandatory IEs is not specified.
5.8.6.1	5.4.2.4.8.2	E E, M	TS 014 uses the concept of 'essential' IEs (not clear whether Q.931 [49] refers just to strictly 'mandatory' IEs or optional IEs which are essential in a given context). Action on detection of a missing essential IE is given by Table 33/D2 (Q.931 [49] sends a STATUS and ignores the message except for SETUP, REL, DISC and REL COM). Handling of SETUP, REL, DISC and REL COM is as per Q.931 [49].

Layer 3 – Primary Rate Departures (Cont.)

ITU–T Rec. Q.931 Reference	ACA TS 014 Clause	CODE	Departure of ACA TS 014 from ITU–T Rec. Q.931 [49]
5.8.6.2	5.4.2.4.8.6.2	E, M E	(Comments as for 5.4.2.4.8.6.1) Q.931 [49] includes a statement that IEs exceeding the maximum length be treated as content error. This is not explicitly stated in TS 014. (implicit in TS 014).
5.8.7.1	5.4.2.4.8.6.3	D A	'Comprehension required' procedure not specified. Sending of a STATUS message is mandatory (optional in Q.931 [49]) Note that text in para 4 of Section 5.7, TS 014, aligns TS 014 Section 5.7.5.3 with Section 5.8.7.1 with respect to DISC, REL and REL COM).
5.8.7.2	5.4.2.4.8.6.4 5.4.2.4.8.6.5	E M E A	TS 014 uses the term 'invalid format or undefined content' (Q.931 [49] refers to invalid content'). However intent is the same in both. TS 014: specified action given in Table 34/D2. Q.931 [49]: optionally send STATUS. Differences mainly affect Ch.Id, Prog. Ind IEs and also other IEs in SETUP. Q.931 [49]: Cause # 43 specified for access information discarded. TS 014: 'most suitable cause'. TS 014: specified action to be taken if the end of the last IE in message is not aligned with the end of the message. Q.931 [49]: similar action specified for network and CE.
5.8.8	5.4.2.4.8.7	D	TS 014: action just specified for CE side Q.931 [49]: similar action specified for network and CE.
5.8.8c	5.4.2.4.8.7(b)	A	TS 014: Send STATUS ENQ. Q.931 [49]: No additional action specified.
5.8	5.4.2.4.8.8	M D A	Q.931 [49]: L3 Entity may optionally Request L2 Re–estab. or clear internally. TS 014: L3 shall request L2 re–estab. On successful re–estab. of L2: Q.931 [49]: options are: no action, send STATUS, or send STATUS ENQ. TS 014: send STAT ENQ. Q.931 [49]: T309 is optional in CE side. TS 014: T309 is optional but desirable on CE side.
5.8.10	5.4.2.4.8.9	D	Q.931 [49]: Procedure involving T322 to monitor completion of STAT ENQ. TS 014: Sending of STAT ENQ and receipt of STATUS in response are considered as independent events.

Layer 3 – Primary Rate Departures (Cont.)

ITU–T Rec. Q.931 Reference	ACA TS 014 Clause	CODE	Departure of ACA TS 014 from ITU–T Rec. Q.931 [49]
5.8.11	5.4.2.4.8.10	D	Q.931 [49]: Procedure applies to all STATUS messages received. TS 014: Just applies to STATUS (Cause # 30); not explicit actions defined for other causes.
		E, A	TS 014: 'Incompatible state ' fully defined. in Tables 34/D2 and 35/D2. Q.931 [49]: 'incompatible state' only partially defined. Also actions more explicitly defined in TS 014. Comparison of actions on receipt of a STATUS message in response to a STATUS ENQ: 1. <u>Peer state is Null & own state is also Null</u> TS 014: RELEASE Q.931 [49]: No Action 2. <u>Peer state other than Null & own state is Null</u> TS 014: RELEASE Q.931: [49] RELEASE or REL COM 3. <u>Peer state other than Null & own state Rel Req</u> TS 014: REL COM. if peer is N6 or U1 otherwise No Action Q.931 [49]: No Action
		D	4. <u>Other</u> TS 014: REL, REL COM or No action as specified. Q.931 [49]: Not specified.
			Q.931 [49]: Specified procedures on receipt of STATUS with global CR. TS 014: STATUS with global CR will be ignored. Network will not send STATUS with global CR.
Annex A	5.4.2.5.2	D	Q.931 [49] SDLs define CE timer T303 in state UI, although Section 5.1 omits it. TS 014: No CE T303.
Annex B	–	D	Compatibility Checking – Not described in detail
Annex C to F	–	D	Not supported
Annex H to J	–	D	Not described
Annex K	–	D	Message segmentation mechanism not supported.
Annex L	–	D	Not described
Annex M to O	–	D	Not supported
Appendix I	–	D	Not described
Appendix II to III	–	D	Not supported

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APPENDICES

A CRC MULTIFRAMES

A1 CRC Multiframes

Each CRC multiframe, **shall** be composed of 16 frames numbered 0 to 15 and **shall** be divided into two 8 frame Sub Multiframes (SMF), designated SMF1 and SMF2 to signifying their respective order of occurrence within the CRC multiframe structure (see Table A1). The SMF block size is the Cyclic Redundancy Check (CRC) block size (i.e. 2048 bits). The CRC multiframe structure is not related to the possible use of a multiframe structure in time slot 16.

Table A1
CRC Multiframe Structure

Frame Number		SMF 2								SMF 1							
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit 1 of the frame	Y bit		Y_4		Y_3		Y_2		Y_1		Y_4		Y_3		Y_2		Y_1
	Z bit	Z_8		Z_7		Z_6		Z_5		Z_4		Z_3		Z_2		Z_1	

A2 Y and Z bits

A2.1 The use of bit 1 over the CRC multiframe is as follows:

(a) In those frames containing the frame alignment signal (even numbered frames as defined in Table 1), bit 1 **shall** be used to transmit the CRC bits. There are four CRC bits in each SMF designated Y_1, Y_2, Y_3, and Y_4;

(b) In those frames not containing the frame alignment signal (odd numbered frames as defined in Table 1), bit 1 **shall** be used to transmit the Z bit. The eight Z bits in a CRC multiframe contain the 6 bit CRC multiframe alignment signal and two CRC error indication bits (E–bits);

(c) The CRC multiframe alignment signal **shall** occupy bits Z_1, Z_2, Z_3, Z_4, Z_5 and Z_6, while the two E–bits E_1 and E_2 **shall** occupy bits Z_7 and Z_8 respectively;

(d) The CRC multiframe alignment signal ($Z_1 - Z_6$) **shall** have the form 001011.

(e) The E–bits **shall** be set to 0 until both basic frame and CRC–4 multiframe alignment are achieved. Thereafter, the E–bits **shall** be used to indicate received errored sub–multiframes by setting the binary state of one E–bit from 1 to 0 for each errored sub–multiframe. Any delay between the detection of an errored SMF and the setting of the E–bit that indicates the error state **shall** be less than 1 second; and

(f) The E–bit **shall** always be taken into account even if the SMF which contains them is found to be errored.

Note: For additional information, refer to ITU–T Rec. G.704 [20].

A3 4 kbit/s CRC Procedure

A3.1 Multiplication/division process

A particular CRC word, located in SMF(N) say, **shall** be the remainder after multiplication by x^4 and then division (modulo 2) by the generator polynomial $x^4 + x + 1$, of the polynomial representation of SMF(N-1).

Note: When representing the contents of the check block as a polynomial, the first bit in the block (i.e. frame 0 bit 1 or frame 8 bit 1) should be taken as being the most significant bit. Similarly, Y_1 is defined to be the most significant bit of the remainder and Y_4 the least significant bit of the remainder.

A3.2 Encoding procedure

A3.2.1 The CRC bit positions in the SMF are initially set to 0, that is $Y_1 = Y_2 = Y_3 = Y_4 = 0$.

A3.2.2 The SMF **shall** then be acted upon by the multiplication/division process referred to above in A3.1.

A3.2.3 The remainder resulting from the multiplication/division process is stored and inserted into the respective CRC locations of the next SMF.

Note: The CRC bits thus generated do not affect the result of the multiplication/division process in the next SMF because, as indicated above, the CRC bit positions in an SMF are initially set to 0 during the multiplication/division process.

A3.3 Decoding procedure

A3.3.1 A received SMF is acted upon by the multiplication/division process, referred to above in A3.1, after having its CRC bits extracted and replaced by 0s.

A3.3.2 The remainder resulting from this process **shall** then be stored and subsequently compared on a bit by bit basis with the CRC bits received in the next SMF.

A3.3.3 If the decoder calculated remainder exactly corresponds to the CRC bits received by the decoder, it **shall** assumed that the checked SMF is error free.

B CAUSE DEFINITIONS

B1 Cause Definitions

This appendix provides definitions to the causes in Clause 5.4.2 The source of each cause is indicated as network (N) or user (U). Causes originating from a user are passed end–to–end in a corresponding message, except causes in the protocol error class.

Table B1
Normal Class

Cause No.		
1	Unassigned (Unallocated) Number	This cause indicates that the destination requested by the calling user cannot be reached because, although the number is in a valid format, it is not currently assigned (allocated).
6	Channel unacceptable	This cause is included by the user or network in the RELEASE message to advise that the B–channel indicated is unacceptable.
16	Normal clearing	This cause indicates that the call is being cleared because one of the users involved in the call has requested that the call be cleared. Under normal situations, the source of this cause is not the network.
17	User Busy	This cause is used when the called user has indicated the inability to accept another call. It is noted that the user equipment is compatible with the call.
18	No user responding	This cause is used when a user does not respond to a call establishment message within the prescribed period of time allocated.
21	Call rejected	This cause indicates that the equipment sending this cause does not wish to accept this call, although it could have accepted the call because the equipment sending the cause is neither busy or incompatible.
22	Number changed	This cause is returned to a user when the called number indicated by the calling party is no longer assigned.

Table B1 (cont.)

Cause No.	
27 Destination out of service	This cause indicates that the destination indicated by the user cannot be reached because the interface to the destination is not functioning correctly. The term 'not functioning correctly' indicates that a signalling message was unable to be delivered to the remote user; e.g. a physical layer or data link layer failure at the remote user, user equipment off–line, etc.
28 Invalid number format (Incomplete number)	This cause indicates that the destination indicated by the calling user cannot be reached because the number is not in a valid format or is not complete.
29 Facility rejected	This cause indicates that the facility indicated is not authorised or is not available.
30 Response to STATUS ENQUIRY	This cause is included in the STATUS message when the reason for generating the STATUS message was the prior receipt of a STATUS ENQUIRY message.
31 Normal, unspecified	This cause is used to report a normal event only when no other cause in the normal class applies.
34 No circuit/channel available	This cause indicates that there is no appropriate circuit/channel, presently available, to handle the call.
38 Network out of order	This cause indicates that the network is not functioning correctly and that the condition is likely to last a relatively long period of time, e.g. immediately re–attempting the call is not likely to be successful.
41 Temporary failure	This cause indicates that the network is not functioning correctly and that the condition is not likely to last a long period of time, e.g. the user may wish to try another call attempt almost immediately.
42 Switching equipment congestion	This cause indicates that the switching equipment generating this cause is experiencing a period of high traffic.
44 Requested circuit/channel not available	This cause indicates that the channel requested by the user during local channel negotiation is not currently available (e.g. engaged or out of service for maintenance).
47 Resource unavailable, unspecified	This cause is used to report a resource unavailable event only when no other cause in the resource unavailable class applies.

Table B3
Service or Option Not Available Class

Cause No.		
57	Bearer capability not authorised	This cause indicates that the user has requested a bearer capability which is implemented by the equipment which generated this cause but the user is not authorised to use.
58	Bearer capability not presently available	This cause indicates that the user has requested a bearer capability which is implemented by the equipment which generated this cause but which is not available at this time.
63	Service or option not available, unspecified	This cause is used to report a service or option not available only when no other cause in the service or option not available class applies (e.g. use of subaddresss not authorised, teleservice request not authorised).

Table B4
Service or Option not Implemented Class

Cause No.		
65	Bearer capability not implemented	This cause indicates that the equipment sending this cause does not support the bearer capability requested; e.g. the call has left the ISDN and entered a network not implementing the requested bearer capability or suitable interworking is not provided to that network.
66	Channel type not implemented	This cause indicates that the equipment sending this cause does not support the channel type requested.
70	Only restricted digital information bearer capability is available	This cause indicates that one equipment has requested an unrestricted bearer service but that the equipment sending this cause only supports the restricted version of the requested bearer capability.
79	Service or option not implemented, unspecified	This cause is used to report a service or option not implemented event only when no other cause in the service or option not implemented class applies.

Table B5
Invalid Message (e.g. Parameter out of Range) Class

Cause No.	
81 Invalid call reference value	This cause indicates that the equipment sending this cause has received a message with a call reference which is not currently in use on the user–network interface.
82 Identified channel does not exist	This cause indicates that the equipment sending this cause has received a request to use a channel not activated on the interface for a call. For example, if a user has subscribed to those channels on a primary rate interface numbered from 1 to 12 and the user equipment or the network attempts to use channels 13 through 30, this cause is generated.
88 Incompatible destination	This cause indicates that the equipment sending this cause has received a request to establish a call which has low layer compatibility, bearer capability, teleservice capability or high layer compatibility attributes which cannot be accommodated.
95 Invalid message, unspecified	This cause is used to report an invalid message event only when no other cause in the invalid message class applies.

Table B6
Protocol Error (e.g. Unknown Message) Class

Cause No.	
96 Mandatory information element is missing	This cause indicates that the equipment sending this cause has received a message which is missing an information element which must be present in the message before that message can be processed.
97 Message type non–existent or not implemented	This cause indicates that the equipment sending this cause has received a message with a message type it does not recognise either because this is a message not defined or defined but not implemented by the equipment sending this cause.
98 Message not compatible with call state, non–existent or not implemented	This general cause indicates that the equipment sending this cause has received a message type in error and is unable to distinguish whether cause # 97 or cause # 101 is appropriate.

Table B6 (cont.)

Cause No.	
99 Information element non–existent or not implemented	This cause indicates that the equipment sending this cause has received a message which includes information elements not recognised because the information element identifier is not defined or it is defined but not implemented by the equipment sending the cause. However, the information element is not required to be present in the message in order for the equipment sending the cause to process the message.
100 Invalid information element contents	This cause indicates that the equipment sending this cause has received an information element which it has implemented; however, one or more of the fields in the information element are coded in such a way which has not been implemented by the equipment sending this cause.
101 Message not compatible with call state	This cause indicates that the equipment sending this cause has received a message such that the procedures do not indicate that this is a permissible message to receive while in the call state, or a STATUS message was received indicating an incompatible call state.
102 Recovery on timer expiry	This cause indicates that a procedure has been initiated by the expiry of a timer in association with call control error handling procedures.
111 Protocol error, unspecified	This cause is used to report a protocol error event only when no other cause in the protocol error class applies.

Table B7
Interworking Class

Cause No.	
127 Interworking, unspecified	This cause indicates that there has been interworking with a network which does not provide causes for actions it takes; thus, the precise cause for a message which is being sent cannot be ascertained.

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C LAYER 2 – TEST MATRIX 1

General Frame/State Tests (States 4-8)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
01	DISC/P=0	A: DM/F=0 S: 4 T: Proper	A: DM/F=0 S: 5 T: Proper	A: UA/F=0 S: 6 T: Proper	A: UA/F=0 S: 4 T: Proper	A: UA/F=0 S: 4 T: Proper
02	DISC/P=0 info. field	MEI-M A: IGN S: 4 T: Improper	MEI-M A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
03	DISC/P=1	A: DM/F=1 S: 4 T: Proper	A: DM/F=1 S: 5 T: Proper	A: UA/F=1 S: 6 T: Proper	A: UA/F=1 S: 4 T: Proper	A: UA/F=1 S: 4 T: Proper
04	SABME/P=0	A: UA/F=0 S: 7 T: Proper A: DM/F=0 S: 4 T: Proper	A: UA/F=0 S: 5 T: Proper	A: DM/F=0 S: 6 T: Proper	MEI-F A: UA/F=0 S: 7 T: Proper	MEI-F A: UA/F=0 S: 7 T: Proper
05	SABME/P=0 info. field	MEI-M A: IGN S: 4 T: Improper	MEI-M A: IGN S: 5 T: Improper	MEI-M A: IGN S: 6 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
06	SABME/P=1	A: UA/F=1 S: 7 T: Proper or A: DM/F=1 S: 4 T: Proper	A: UA/F=1 S: 5 T: Proper	A: DM/F=1 S: 6 T: Proper	MEI-F A: UA/F=1 S: 7 T: Proper	MEI-F A: UA/F=1 S: 7 T: Proper
07	UA/F=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: IGN S: 7 T: Inopportune	A: IGN S: 8 T: Inopportune
08	UA/F=0 info. field	MEI-M A: IGN S: 4 T: Improper	MEI-M A: IGN S: 5 T: Improper	MEI-M A: IGN S: 6 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
09	UA/F=1	A: IGN S: 4 T: Inopportune	A: DT S: 7 T: Proper or A: IGN S: 5 T: Inopportune	A: DT S: 4 T: Proper or A: IGN S: 6 T: Inopportune	A: IGN S: 7 T: Inopportune	A: IGN S: 8 T: Inopportune

Layer 2 - Test Matrix 1(cont.)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
10	DM/F=0	A: IGN S: 4 T: Proper or A: SABME/P=1 S: 5 T: Proper	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	MEI-E A: SABME/P=1 S: 5 T: Proper	MEI-E A: SABME/P=1 S: 5 T: Proper
11	DM/F=0 info. field	MEI-M A: IGN S: 4 T: Improper	MEI-M A: IGN S: 5 T: Improper	MEI-M A: IGN S: 6 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
12	DM/F=1	A: IGN S: 4 T: Inopportune	A: DT S: 4 T: Proper	A: DT S: 4 T: Proper	MEI-B A: IGN S: 7 T: Inopportune	MEI-B A: SABME/P=1 S: 5 T: Proper
13	I/P = 0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: RR/F=0 S: 7 T: Proper or [ORB-CONDITION] A: DT S: 7,ORB T: Proper or [I-QUEUE] A: I/P=0 S: 7 T: Proper	A: RR/F=0 S: 8 T: Proper or [ORB-CONDITION] A: DT S: 8,ORB T: Proper
14	I/P = 0 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper A: RR/F=0 SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper A: RR/F=0 SABME/P=1 S: 5 T: Improper
15	I/P = 0 invalid N(S)				A: REJ/F=0 S: 7,REJ T: Proper or [ORB-CONDITION] A: DT S: 7,ORB T: Proper or [I-QUEUE] A: I/P=0 S: 7 T: Proper	A: REJ/F=0 S: 8,REJ T: Proper or [ORB-CONDITION] A: DT S: 8,ORB T: Proper

Layer 2 - Test Matrix 1(cont.)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
16	I/P = 0 invalid N(S) and N(R)				A: REJ/F=0 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	A: REJ/F=0 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
17	I/P = 0 too long >N201	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	MEI-O A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-O A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
18	I/P = 0 no I field	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: RR/F=0 S: 7 T: Proper or [ORB-CONDITION] A: DT S: 7,ORB T: Proper or [I-QUEUE] A: I/P=0 S: 7 T: Proper	A: RR/F=0 S: 8 T: Proper or [ORB-CONDITION] A: DT S: 8,ORB T: Proper
19	I/P = 1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: RR/F=1 S: 7 T: Proper or [ORB-CONDITION] A: RNR/F=1 S: 7,ORB T: Proper	A: RR/F=1 S: 8 T: Proper or [ORB-CONDITION] A: RNR/F=1 S: 8,ORB T: Proper

Layer 2 - Test Matrix 1(cont.)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
20	I/P = 1 invalid N(R)				A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper or MEI-J A: SABME/P=1 S: 5 T: Improper	A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper or MEI-J A: SABME/P=1 S: 5 T: Improper
21	RR/P=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: DT S: 7 T: Proper or [I-QUEUE] A: I/P=0 S: 7 T: Proper	A: DT S: 8 T: Proper
22	RR/P=0 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
23	RR/P=0 info. field	MEI-M A: IGN S: 4 T: Improper	MEI-M A: IGN S: 5 T: Improper	MEI-M A: IGN S: 6 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
24	RR/P=1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: RR/F=1 S: 7 T: Proper or [ORB-CONDITION] A: RNR/F=1 S: 7,ORB T: Proper	A: RR/F=1 S: 8 T: Proper or [ORB-CONDITION] A: RNR/F=1 S: 8,ORB T: Proper

Layer 2 - Test Matrix 1(cont.)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
25	RR/P=1 invalid N(R)				A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or A: FRMR SABME/P=1 S: 5 T: Improper or A: SABME/P=1 S: 5 T: Improper	A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or A: FRMR SABME/P=1 S: 5 T: Improper or A: SABME/P=1 S: 5 T: Improper
26	RR/F=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: DT S: 7 T: Proper or [I-QUEUE] A: I/P = 0 S: 7 T: Proper	A: DT S: 8 T: Proper
27	RR/F=0 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
28	RR/F=1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	MEI-A A: DT S: 7 T: Inopportune or [I-QUEUE] A: I/P=0 S: 7 T: Inopportune	(RE-TRANSMIT) A: I/P=0 S: 7 T: Proper
29	RR/F=1 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
30	RNR/P=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: DT S: 7 T: Proper	A: DT S: 8 T: Proper

Layer 2 - Test Matrix 1(cont.)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
31	RNR/P=0 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
32	RNR/P=0 info. field	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
33	RNR/P=1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: RR/F=1 S: 7 T: Proper or [ORB-CONDITION] A: RNR/F=1 S: 7,ORB T: Proper	A: RR/F=1 S: 8 T: Proper or [ORB-CONDITION] A: RNR/F=1 S: 8,ORB T: Proper
34	RNR/P=1 invalid N(R)				A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper MEI-J A: SABME/P=1 S: 5 T: Improper	A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper MEI-J A: SABME/P=1 S: 5 T: Improper
35	RNR/F=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: DT S: 7 T: Proper	A: DT S: 8 T: Proper
36	RNR/F=0 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
37	RNR/F=1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	MEI-A A: DT S: 7 T: Inopportune	A: DT S: 7 T: Proper

Layer 2 - Test Matrix 1(cont.)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
38	RNR/F=1 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
39	REJ/P=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	(RE-TRANSMIT) A: I/P = 0 S: 7 T: Proper	A: DT S: 8 T: Proper
40	REJ/P=0 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
41	REJ/P=0 info. field	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-M A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
42	REJ/P=1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	A: RR/F=1 (RE-TRANSMIT) I/P= 0 S: 7 T: Proper or [ORB-CONDITION] A: RNR/F=1 (RE-TRANSMIT) I/P = 0 S: 7 T: Proper	A: RR/F=1 S: 8 T: Proper or [ORB-CONDITION] A: RNR/F=1 S: 8 T: Proper
43	REJ/P=1 invalid N(R)				A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper MEI-J A: SABME/P=1 S: 5 T: Improper	A: RR/F=1 MEI-J SABME/P=1 S: 5 T: Improper or [ORB-CONDITION] A: RNR/F=1 MEI-J SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper MEI-J A: SABME/P=1 S: 5 T: Improper
44	REJ/F=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	(RE-TRANSMIT) A: I/P = 0 S: 7 T: Proper	A: DT S: 8 T: Proper

Layer 2 - Test Matrix 1(cont.)

Row No.	Command or Response received by IUT	TEI assigned (4)	Awaiting establishment (5)	Awaiting release (6) (OPTIONAL TEST)	Multiple Frame Established (7)	Timer Recovery (8)
45	REJ/F=0 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
46	REJ/F=1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	MEI-A (RE-TRANSMIT) A: I/P = 0 S: 7 T: Inopportune	(RE-TRANSMIT) A: I/P = 0 S: 7 T: Proper
47	REJ/F=1 invalid N(R)				MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-J A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
48	Unknown command	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	MEI-L A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-L A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
49	Unknown response	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	MEI-L A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper	MEI-L A: SABME/P=1 S: 5 T: Improper A: FRMR SABME/P=1 S: 5 T: Improper
50	Incorrect address	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper
51	FCS error	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper
52	Less than 5 octets between flags	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper
53	FRMR/F=0	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	MEI-K A: SABME/P=1 S: 5 T: Inopportune	MEI-K A: SABME/P=1 S: 5 T: Inopportune
54	FRMR/F=1	A: IGN S: 4 T: Inopportune	A: IGN S: 5 T: Inopportune	A: IGN S: 6 T: Inopportune	MEI-K A: SABME/P=1 S: 5 T: Inopportune	MEI-K A: SABME/P=1 S: 5 T: Inopportune
55	Non -ntegral no. of octets	A: IGN S: 4 T: Improper	A: IGN S: 5 T: Improper	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper
57	Invoke sequential Information transmission				A: I/P=0 [N(S):0-127] (Note 1) S: 7 T: Proper	

Note: Refer to Clause 6.3.2.1 for key definitions.

D LAYER 2 – TEST MATRIX 2

User Side Timer/Parameters (States 5–8)

Row No.	User Timer Condition	State 5	State 6 (Optional Test)	State 7	State 8 (Note 2)
01	T200 First expiry	A: SABME/P=1 S: 5 T: Inopportune	A: DISC/P=1 S: 6 T: Inopportune	(RE-TRANSMIT) A: I/P=1 S: 8 T: Inopportune or [PRB & ORB COND] A: RNR/P=1 S: 8 T: Inopportune or [PRB-CONDITION] A: RR/P=1 S: 8 T: Inopportune	A: RR/P=1 or S: 8 T: Inopportune or [PRB & ORB COND] A: RNR/P=1 S: 8 T: Inopportune or (RE-TRANSMIT) A: I/P=1 S: 8 T: Inopportune
02	T200 expires = N200	MEI-G DL-RELEASE-IND A: DT S: 4 T: Inopportune	MEI-H DL-RELEASE-CONF A: DT S: 4 T: Inopportune		MEI-I A: SABME/P=1 S: 5 T: Inopportune
03	T203 expires (OPTIONAL)			A: RR/P=1 S: 8 T: Inopportune or [ORB-CONDITION] A: RNR/P=1 S: 8 T: Inopportune	

Note 1: Refer to Clause 6.2.3.1 for key definitions.

Note 2: Due to the state checking procedure in state 8, the data link may move to state 5.

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E LAYER 2 – STATE INITIALISATION (STATE 4–8)

E.1 This appendix is only provided as a recommended means of state initialisation for tests in Appendices C and D. Test houses may choose to use other sequences.

Note: The information contained in this appendix has the network (tester) firing frames from the left side, and the user firing frames from the right.

STATE 4: TEI ASSIGNED	
Network (Tester) →	**User states (Terminal)** ←
DISC/P=1 →	
	if S4: DM/F=1 (to STATE 4) if S5: DM/F=1 (to STATE 5) if S6: DM/F=1 (to STATE 6) if S7: DM/F=1 (to STATE 7) if S8: DM/F=1 (to STATE 8) ←
DM/F=1 →	
	STATE 4 (from States 4,5 & 6)

ALL STATES ARE INITIALISED BY FIRST INITIALIZING TO A KNOWN STATE: STATE 4 (as above)

STATE 5: AWAITING ESTABLISHMENT	
Network (Tester) →	**User states (Terminal)** ←
STATE 4 Initialization (as above) then: SABME/P=1 → DM/F=0 →	in S4: UA/F=1 (to STATE 7) ← in S7: SABME/P=1 (to STATE 5) ←
OR	
STATE 4 Initialization then: DM/F=0 →	in S4: SABME/P=1 (to STATE 5) ←

STATE 6: AWAITING RELEASE	
Network (Tester) →	**User states (Terminal)** ←
STATE 4 Initialization then: SABME/P=1 → No response	in S4: UA/F=1 (to STATE 7) ← in S7: DISC/P=1 (to STATE 6) ←
OR	
STATE 4 Initialization then: DM/F=0 UA/F=1 No response	in S4: SABME/P=1 (to STATE 5) ← (to state 7): no response by user in S7: DISC/P=1 (to STATE 6) ←

STATE 7: MULTIPLE FRAME ESTABLISHED	
Network (Tester) →	**User states (Terminal)** ←
STATE 4 Initialization then: SABME/P=1 →	in S4: UA/F=1 (to STATE 7) ←
OR	
STATE 4 Initialization then: DM/F=0 → UA/F=1 →	in S4: SABME/P=1 (to STATE 5) ← (to STATE 7): no response in S5
OR	
STATE 4 Initialization then: UA/F=1 →	in S4: SABME/P=1 (to STATE 5) {*Manual invocation*} ← (to STATE 7): no response in S5

The initialisation above is under normal conditions.

STATE 8: TIMER RECOVERY	
Network (Tester) →	**User states (Terminal)** ←
STATE 4 Initialization then: SABME/P=1 → RNR/P=1 →	in S4: UA/F=1 (to STATE 7) ← in S7: RR/F=1 ← in S7: RR/P=1 (T200 Expires – to STATE 8) ←

The initialisation above is under normal conditions.

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F LAYER 2 – STATE CHECK SEQUENCES (STATES 4–8)

This appendix is only provided as a recommended means of state checking for tests in Appendices C and D. Test houses may choose to use other sequences.

Note: The information contained in this appendix has the network (tester) firing frames from the left side, and the user firing frames from the right.

STATE 4: TEI ASSIGNED	
Network (Tester) →	**User states (Terminal)** ←
DISC/P=1 →	if S4: DM/F=1 (to STATE 4) Note: if S5: DM/F=1 (to STATE 5) has same response ←

Note: If required to differentiate between state 4 and state 5 response, use State 5 Verification Test.

STATE 5: AWAITING ESTABLISHMENT	
Network (Tester) →	**User states (Terminal)** ←
UA/F=1 →	in S5: no response (to STATE 7) Note: in S4: UI: ID verify (Ri, Ai) – (to STATE 4) or MEI–C no response (to STATE 1) has same response. in S6: no response (to STATE 4) has same response ←
To further differentiate between STATE 7 and STATE 4: I/P=0,N(S)=0 →	in S4: no response (to STATE 4) in S7: RR/F=0, N(R) = 1 or I/P=0, N(R) = 1 or RNR/F=0, N(R) = 1 ←

Layer 2 – State Check sequences (State 4-8) (cont.)

OR	
If no response expected from TE initially (e.g. due to an invalid frame response) use:	
	in S5: SABME/P=1 after T200 expiry ←
UA/F=1 →	
STATE 6: AWAITING RELEASE	
Network (Tester) →	**User states (Terminal)** ←
SABME/P=1 →	
	in S6: DM/F=1 (to STATE 6) Note: in S4: DM=F=1 (to STATE 4) has same response ←
UA/F=1 →	
If need to differentiate further between STATE 6 and STATE 4: DISC/P=1 →	
	in S6: UA/F=1 (to STATE 6) in S4: DM/F=1 (to STATE 4) ←
OR	
if no response expected from TE initially (e.g. due to an invalid frame response) use:	
	in S6: DISC/P=1 after T200 expiry ←
UA/F=1 →	

Layer 2 – State Check sequences (State 4-8) (cont.)

STATE 7: MULTIPLE FRAME ESTABLISHED	
Network (Tester)	**User states (Terminal)**
I/P=1 (REL COM)	
	RR/F=1
DM/F=1	
	No Response
DISC/P=1	
	UA/F=1

STATE 8: TIMER RECOVERY	
Network (Tester)	**User states (Terminal)**
I/P=1 (REL COM)	
	RR/F=1
DM/F=1	
	SABME/P=1 OR RR/P=1 (i.e. T200 expiry)
DISC/P=1	
	SABME/P=1 OR DM/F=1

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G LAYER 3 – PRIMARY RATE TEST MATRIX 1

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
1	ALERTing	A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune A: DT S: 4 T: Proper	A: DT S: 4 T: Proper	A: DT S: 4 T: Proper	A: STATUS/C=101,S=4 S: 4 T: Inopportune A: STATUS ENQUIRY S: 4 T: Inopportune
2	CALL PROCeeding	A: DT S: 3 T: Proper	A: DT S: 3 T: Proper	A: STATUS/C=101,S=3 S: 3 T: Inopportune A: STATUS ENQUIRY S: 3 T: Inopportune	A: STATUS/C=101,S=4 S: 4 T: Inopportune A: STATUS ENQUIRY S: 4 T: Inopportune
3	CONNect	A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune A: DT S: 10 T: Proper A: CONN ACK S: 10 T: Proper	A: DT S: 10 T: Proper A: CONN ACK S: 10 T: Proper	A: DT S: 10 T: Proper A: CONN ACK S: 10 T: Proper	A: DT S: 10 T: Proper A: CONN ACK S: 10 T: Proper
4	CONNect ACK	A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune	A: STATUS/C=101,S=2 S: 2 T: Inopportune A: STATUS ENQUIRY S: 2 T: Inopportune	A: STATUS/C=101,S=3 S: 3 T: Inopportune A: STATUS ENQUIRY S: 3 T: Inopportune	A: STATUS/C=101,S=4 S: 4 T: Inopportune A: STATUS ENQUIRY S: 4 T: Inopportune

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
5	DISConnect	A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune A: REL (Note 1) S: 19 T: Proper	A: REL S: 19 T: Proper A: DET S: 12 T: Proper	A: REL S: 19 T: Proper A: DET S: 12 T: Proper	A: REL S: 19 T: Proper A: DET S: 12 T: Proper
6	INFOrmation (include DISP. IE)	A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune A: STATUS/C=97,S=1 S: 1 T: Improper	A: STATUS/C=101,S=2 S: 2 T: Inopportune A: STATUS ENQUIRY S: 2 T: Inopportune A: STATUS/C=97,S=2 S: 2 T: Improper	A: STATUS/C=101,S=3 S: 3 T: Inopportune A: STATUS ENQUIRY S: 3 T: Inopportune A: STATUS/C=97,S=3 S: 3 T: Improper	A: STATUS/C=101,S=4 S: 4 T: Inopportune A: STATUS ENQUIRY S: 4 T: Inopportune A: STATUS/C=97,S=4 S: 4 T: Improper
7	NOTIFY	A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS/C=97,S=1 S: 1 T: Improper A: STATUS ENQUIRY S: 1 T: Improper/Inopportune	A: STATUS/C=101,S=2 S: 2 T: Inopportune A: STATUS/C=97,S=2 S: 2 T: Improper A: STATUS ENQUIRY S: 2 T: Improper/Inopportune	A: STATUS/C=101,S=3 S: 3 T: Inopportune A: STATUS/C=97,S=3 S: 3 T: Improper A: STATUS ENQUIRY S: 3 T: Improper/Inopportune	A: STATUS/C=101,S=4 S: 4 T: Inopportune A: STATUS/C=97,S=4 S: 4 T: Improper A: STATUS ENQUIRY S: 4 T: Improper/Inopportune
8	PROGress	A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune	A: DT S: 2 T: Proper	A: DT S: 3 T: Proper	A: STATUS/C=101,S=4 S: 4 T: Inopportune A: STATUS ENQUIRY S: 4 T: Inopportune
9	RELease	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
10	RELease COMplete	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper
11	SETUP Call Ref. flag=1	A: IGN S: 1 T: Improper/Inopportune	A: IGN S: 2 T: Improper/Inopportune	A: IGN S: 3 T: Improper/Inopportune	A: IGN S: 4 T: Improper/Inopportune
12	SETUP ACK	A: DT S: 2 T: Proper A: INFO S: 2 T: Proper	A: STATUS/C=101,S=2 S: 2 T: Inopportune A: STATUS ENQUIRY S: 2 T: Inopportune	A: STATUS/C=101,S=3 S: 3 T: Inopportune A: STATUS ENQUIRY S: 3 T: Inopportune	A: STATUS/C=101,S=4 S: 4 T: Inopportune A: STATUS ENQUIRY S: 4 T: Inopportune
13	STATUS (cause not=30, state=same)	A: DT S: 1 T: Proper	A: DT S: 2 T: Proper	A: DT S: 3 T: Proper	A: DT S: 4 T: Proper
14	STATUS ENQUIRY	A: STATUS/C=30,S=1 S: 1 T: Proper	A: STATUS/C=30,S=2 S: 2 T: Proper	A: STATUS/C=30,S=3 S: 3 T: Proper	A: STATUS/C=30,S=4 S: 4 T: Proper
15	Overlap Sending by User (optional)	NA	A: INFO S: 2 T: Proper	NA	NA
16	User Initiated Clearing	A: DISC S: 11 T: Proper A: REL S: 19 T: Proper	A: DISC S: 11 T: Proper A: REL S: 19 T: Proper	A: DISC S: 11 T: Proper A: REL S: 19 T: Proper	A: DISC S: 11 T: Proper A: REL S: 19 T: Proper
17	NO Action				A: DT S: 4 T: Proper
18	RESTART (all interface)	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper
19	RESTART (channel)	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
21	RESTART ACK	A: IGN S: 1 T: Inopportune	A: IGN S: 2 T: Inopportune	A: IGN S: 3 T: Inopportune	A: IGN S: 4 T: Inopportune
22	STATUS/ C=30, S=0	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper
35	Protocol Discriminator Error	A: IGN S: 1 T: Improper	A: IGN S: 2 T: Improper	A: IGN S: 3 T: Improper	A: IGN S: 4 T: Improper
36	Message too short	A: IGN S: 1 T: Improper	A: IGN S: 2 T: Improper	A: IGN S: 3 T: Improper	A: IGN S: 4 T: Improper
37	Invalid Call Reference Format (incorrect length 3 octets)	A: IGN S: 1 T: Improper	A: IGN S: 2 T: Improper	A: IGN S: 3 T: Improper	A: IGN S: 4 T: Improper
38	Call Reference Procedural Error (Global call ref.)	A: IGN S: 1 T: Improper A: STATUS/C=81 (Global CR) S: 1 T: Improper	A: IGN S: 2 T: Improper A: STATUS/C=81 (Global CR) S: 2 T: Improper	A: IGN S: 3 T: Improper A: STATUS/C=81 (Global CR) S: 3 T: Improper	A: IGN S: 4 T: Improper A: STATUS/C=81 (Global CR) S: 4 T: Improper
39	Call Reference Procedural Error (Non global call ref) [Note: Response is for different Call Reference]	A: REL/C=81 S: 1 T: Improper A: REL COM/C=81 S: 1 T: Improper	A: REL/C=81 S: 2 T: Improper A: REL COM/C=81 S: 2 T: Improper	A: REL/C=81 S: 3 T: Improper A: REL COM/C=81 S: 3 T: Improper	A: REL/C=81 S: 4 T: Improper A: REL COM/C=81 S: 4 T: Improper
41	Message Type Not Implemented	A: STATUS/C=97,S=1 S: 1 T: Improper A: STATUS ENQUIRY S: 1 T: Improper	A: STATUS/C=97,S=2 S: 2 T: Improper A: STATUS ENQUIRY S: 2 T: Improper	A: STATUS/C=97,S=3 S: 3 T: Improper A: STATUS ENQUIRY S: 3 T: Improper	A: STATUS/C=97,S=4 S: 4 T: Improper A: STATUS ENQUIRY S: 4 T: Improper
42	ALERTing Progress content error		A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=4(2) S: 4 T: Improper A: DT S: 4 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=4(3) S: 4 T: Improper A: DT S: 4 T: Improper	

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
44	CALL PROCeeding Channel Id missing	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=1 S: 1 T: Improper	A: DT S: 3 T: Improper		
45	CALL PROCeeding Channel Id content error	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=1 S: 1 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=2(3) S: 3 T: Improper A: DT S: 3 T: Improper		
46	CALL PROCeeding Progress content error	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=1(3) S: 3 T: Improper A: DT S: 3 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=2(3) S: 3 T: Improper A: DT S: 3 T: Improper		

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
48	CONNect Progress content error		A: REL/C=100 S: 19 T: Improper A: DT S: 10 T: Improper A: STATUS/C=100, S=2(10) S: 10 T: Improper A: CONN ACK S: 10 T: Improper A: CONN ACK STATUS/C=100,S=10 S: 10 T: Improper A: STATUS/C=100, S=2(10) CONN ACK S: 10 T: Improper	A: REL/C=100 S: 19 T: Improper A: DT S: 10 T: Improper A: STATUS/C=100, S=3(10) S: 10 T: Improper A: CONN ACK S: 10 T: Improper A: CONN ACK STATUS/C=100,S=10 S: 10 T: Improper A: STATUS/C=100, S=3(10) CONN ACK S: 10 T: Improper	A: REL/C=100 S: 19 T: Improper A: DT S: 10 T: Improper A: STATUS/C=100, S=4(10) S: 10 T: Improper A: CONN ACK S: 10 T: Improper A: CONN ACK STATUS/C=100,S=10 S: 10 T: Improper A: STATUS/C=100, S=4(10) CONN ACK S: 10 T: Improper
50	DISConnect Cause missing	A: REL (Note 1) S: 19 T: Improper A: REL STATUS/C= ,S=19 S: 19 T: Improper A: STATUS/C= ,S=12(1) REL S: 19 T: Improper A: DET STATUS/C= ,S=13 S: 13 T: Improper A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune	A: REL S: 19 T: Improper A: REL STATUS/C=96,S=19 S: 19 T: Improper A: STATUS/C=96,S=12(2) REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=96,S=19 S: 19 T: Improper A: STATUS/C=96,S=12(3) REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=96,S=19 S: 19 T: Improper A: STATUS/C=96,S=12(4) REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
51	DISConnect Cause content error	A: REL (Note 1) S: 19 T: Improper A: REL STATUS/C= ,S=19 S: 19 T: Improper A: STATUS/C= , S=12(1) REL S: 19 T: Improper A: DET STATUS/C= ,S=13 S: 13 T: Improper A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune	A: REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100, S=12(2) REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100, S=12(3) REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100, S=12(4) REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper
52	DISConnect Progress content error	A: REL (Note 1) S: 19 T: Improper A: REL STATUS/C= ,S=19 S: 19 T: Improper A: STATUS/C= , S=12(1) REL S: 19 T: Improper A: DET STATUS/C= ,S=13 S: 13 T: Improper A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune	A: REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100, S=12(2) REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100, S=12(3) REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100, S=12(4) REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
54	PROGress Progress missing		A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=2 S: 2 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=3 S: 3 T: Improper	
55	PROGress Progress content error		A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=2 S: 2 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=3 S: 3 T: Improper	
57	RELease Cause missing	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper
58	RELease Cause content error	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper
59	RELease Display content error	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=1(0) REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=2(0) REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=3(0) REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=4(0) REL COM S: 0 T: Improper
60	RELease COMplete Cause missing	A: DT S: 0 T: Improper			
61	RELease COMplete Cause content error	A: DT S: 0 T: Improper			
63	SETUP Bearer Cap Missing Call Ref. flag=1	A: IGN S: 1 T: Improper	A: IGN S: 2 T: Improper	A: IGN S: 3 T: Improper	A: IGN S: 4 T: Improper
64	SETUP Bearer Cap. corrupt Call Ref. flag=1	A: IGN S: 1 T: Improper	A: IGN S: 2 T: Improper	A: IGN S: 3 T: Improper	A: IGN S: 4 T: Improper
66	SETUP ACK Channel Id missing	A: REL/C=96,S=19 S: 19 T: Improper A: STATUS/C=96,S=1 S: 1 T: Improper			

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
67	SETUP ACK Channel Id content error	A: REL/C=100,S=19 S: 19 T: Improper A: STATUS/C=100,S=1 S: 1 T: Improper			
68	SETUP ACK Progress content error	A: REL/C=100,S=19 S: 19 T: Improper A: STATUS/C=100,S=1(2) S: 2 T: Improper A: DT S: 2 T: Improper A: INFO S: 2 T: Improper A: INFO STATUS/C=100,S=1(2) S: 2 T: Improper			
70	STATUS Cause missing	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=1 S: 1 T: Improper A: DT S: 1 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=2 S: 2 T: Improper A: DT S: 2 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=3 S: 3 T: Improper A: DT S: 3 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=4 S: 4 T: Improper A: DT S: 4 T: Improper
71	STATUS Cause content error	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=1 S: 1 T: Improper A: DT S: 1 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=2 S: 2 T: Improper A: DT S: 2 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=3 S: 3 T: Improper A: DT S: 3 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=4 S: 4 T: Improper A: DT S: 4 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
72	STATUS/C=30 State missing	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=1 S: 1 T: Improper A: DT S: 1 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=2 S: 2 T: Improper A: DT S: 2 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=3 S: 3 T: Improper A: DT S: 3 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=4 S: 4 T: Improper A: DT S: 4 T: Improper
73	STATUS/C=43 State content	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=1 S: 1 T: Improper A: DT S: 1 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=2 S: 2 T: Improper A: DT S: 2 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=3 S: 3 T: Improper A: DT S: 3 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=4 S: 4 T: Improper A: DT S: 4 T: Improper
89	RESTART Restart indicator missing	A: IGN S: 1 T: Improper A: STATUS/C=96 (Global CR) S: 1 T: Improper	A: IGN S: 2 T: Improper A: STATUS/C=96 (Global CR) S: 2 T: Improper	A: IGN S: 3 T: Improper A: STATUS/C=96 (Global CR) S: 3 T: Improper	A: IGN S: 4 T: Improper A: STATUS/C=96 (Global CR) S: 4 T: Improper
90	RESTART Restart indicator content	A: IGN S: 1 T: Improper A: STATUS/C=100 (Global CR) S: 1 T: Improper	A: IGN S: 2 T: Improper A: STATUS/C=100 (Global CR) S: 2 T: Improper	A: IGN S: 3 T: Improper A: STATUS/C=100 (Global CR) S: 3 T: Improper	A: IGN S: 4 T: Improper A: STATUS/C=100 (Global CR) S: 4 T: Improper
91	RESTART (channel) Channel Id content	A: IGN S: 1 T: Improper A: STATUS/C=100 (Global CR) S: 1 T: Improper	A: IGN S: 2 T: Improper A: STATUS/C=100 (Global CR) S: 2 T: Improper	A: IGN S: 3 T: Improper A: STATUS/C=100 (Global CR) S: 3 T: Improper	A: IGN S: 4 T: Improper A: STATUS/C=100 (Global CR) S: 4 T: Improper
118	ALERTing IE not implemented		A: STATUS/C=99,S=4(2) S: 4 T: Improper A: DT S: 4 T: Improper	A: STATUS/C=99,S=4(3) S: 4 T: Improper A: DT S: 4 T: Improper	

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
119	CALL PROCeeding IE not implemented	A: STATUS/C=99,S=3(1) S: 3 T: Improper A: DT S: 3 T: Improper	A: STATUS/C=99,S=3(2) S: 3 T: Improper A: DT S: 3 T: Improper		
120	CONNect IE not implemented		A: STATUS/C=99,S=10(2) S: 10 T: Improper A: DT S: 10 T: Improper A: CONN ACK STATUS/C=99,S=10 S: 10 T: Improper A: CONN ACK S: 10 T: Improper A: STATUS/C=99,S=2(10) CONN ACK S: 10 T: Improper	A: STATUS/C=99,S=10(3) S: 10 T: Improper A: DT S: 10 T: Improper A: CONN ACK STATUS/C=99,S=10 S: 10 T: Improper A: CONN ACK S: 10 T: Improper A: STATUS/C=99,S=3(10) CONN ACK S: 10 T: Improper	A: STATUS/C=99,S=10(4) S: 10 T: Improper A: DT S: 10 T: Improper A: CONN ACK STATUS/C=99,S=10 S: 10 T: Improper A: CONN ACK S: 10 T: Improper A: STATUS/C=99,S=4(10) CONN ACK S: 10 T: Improper
121	DISConnect IE not implemented	A: REL (Note 1) S: 19 T: Improper A: REL STATUS/C= ,S=19 S: 19 T: Improper A: STATUS/C= ,S=12(1) REL S: 19 T: Improper A: DET STATUS/C= ,S=13 S: 13 T: Improper A: STATUS/C=101,S=1 S: 1 T: Inopportune A: STATUS ENQUIRY S: 1 T: Inopportune	A: REL S: 19 T: Improper A: REL STATUS/C=99,S=19 S: 19 T: Improper A: STATUS/C=99,S=12(2) REL S: 19 T: Improper A: DET STATUS/C=99,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=99,S=19 S: 19 T: Improper A: STATUS/C=99,S=12(3) REL S: 19 T: Improper A: DET STATUS/C=99,S=13 S: 13 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=99,S=19 S: 19 T: Improper A: STATUS/C=99,S=12(4) REL S: 19 T: Improper A: DET STATUS/C=99,S=13 S: 13 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
122	PROGress IE not implemented		A: STATUS/C=99,S=2 S: 2 T: Improper A: DT S: 2 T: Improper	A: STATUS/C=99,S=3 S: 3 T: Improper A: DT S: 3 T: Improper	
123	RELease IE not implemented	A: REL COM S: 0 T: Improper A: STATUS/C=99 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=99 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=99 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=99 REL COM S: 0 T: Improper
124	RELease COMplete IE not implemented	A: DT (Note 3) S: 0 T: Improper A: STATUS/C=99 S: 0 T: Improper			
125	SETUP IE not implemented Call Ref. flag=1	A: IGN S: 1 T: Inopportune	A: IGN S: 2 T: Inopportune	A: IGN S: 3 T: Inopportune	A: IGN S: 4 T: Inopportune
126	SETUP ACK IE not implemented	A: STATUS/C=99,S=2 S: 2 T: Improper A: DT S: 2 T: Improper A: INFO S: 2 T: Improper A: INFO STATUS/C=99,S=2 S: 2 T: Improper			
127	STATUS IE not implemented (cause not=30)	A: STATUS/C=99,S=1 S: 1 T: Improper A: DT S: 1 T: Improper	A: STATUS/C=99,S=2 S: 2 T: Improper A: DT S: 2 T: Improper	A: STATUS/C=99,S=3 S: 3 T: Improper A: DT S: 3 T: Improper	A: STATUS/C=99,S=4 S: 4 T: Improper A: DT S: 4 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Originating Call Establishment			
		U1 Call Init.	U2 Overlap sending	U3 O/G Call proceeding	U4 Call delivered
128	STATUS ENQUIRY IE not implemented	A: STATUS/C=30,99,S=1 S: 1 T: Improper A: STATUS/C=30,S=1 STATUS/C=99,S=1 S: 1 T: Improper A: STATUS/C=30,S=1 S: 1 T: Improper A: STATUS/C=99,S=1 STATUS/C=30,S=1 S: 1 T: Improper	A: STATUS/C=30,99,S=2 S: 2 T: Improper A: STATUS/C=30,S=2 STATUS/C=99,S=2 S: 2 T: Improper A: STATUS/C=30,S=2 S: 2 T: Improper A: STATUS/C=99,S=2 STATUS/C=30,S=2 S: 2 T: Improper	A: STATUS/C=30,99,S=3 S: 3 T: Improper A: STATUS/C=30,S=3 STATUS/C=99,S=3 S: 3 T: Improper A: STATUS/C=30,S=3 S: 3 T: Improper A: STATUS/C=99,S=3 STATUS/C=30,S=3 S: 3 T: Improper	A: STATUS/C=30,99,S=4 S: 4 T: Improper A: STATUS/C=30,S=4 STATUS/C=99,S=4 S: 4 T: Improper A: STATUS/C=30,S=4 S: 4 T: Improper A: STATUS/C=99,S=4 STATUS/C=30,S=4 S: 4 T: Improper
129	RESTART IE not implemented	A: RESTART ACK S: 0 T: Improper	A: RESTART ACK S: 0 T: Improper	A: RESTART ACK S: 0 T: Improper	A: RESTART ACK S: 0 T: Improper
130	STATUS/ C=30,S=0 IE not implemented	A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)

H LAYER 3 – PRIMARY RATE TEST MATRIX 2

Row No.	Message received by IUT	Destination Call Establishment			
		U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
1	ALERTing	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS ENQUIRY S: 6 T: Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS ENQUIRY S: 7 T: Inopportune	A: STATUS/C=101,S=8 S: 8 T: Inopportune A: STATUS ENQUIRY S: 8 T: Inopportune	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS ENQUIRY S: 9 T: Inopportune
2	CALL PROCeeding	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS ENQUIRY S: 6 T: Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS ENQUIRY S: 7 T: Inopportune	A: STATUS/C=101,S=8 S: 8 T: Inopportune A: STATUS ENQUIRY S: 8 T: Inopportune	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS ENQUIRY S: 9 T: Inopportune
3	CONNect	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS ENQUIRY S: 6 T: Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS ENQUIRY S: 7 T: Inopportune	A: STATUS/C=101,S=8 S: 8 T: Inopportune A: STATUS ENQUIRY S: 8 T: Inopportune	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS ENQUIRY S: 9 T: Inopportune
4	CONNect ACK	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS ENQUIRY S: 6 T: Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS ENQUIRY S: 7 T: Inopportune	A: DT S: 10 T: Proper	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS ENQUIRY S: 9 T: Inopportune
5	DISConnect	A: REL S: 19 T: Proper A: DET S: 13 T: Proper A: DT S: 12 T: Proper	A: REL S: 19 T: Proper A: DET S: 13 T: Proper A: DT S: 12 T: Proper	A: REL S: 19 T: Proper A: DET S: 13 T: Proper A: DT S: 12 T: Proper	A: REL S: 19 T: Proper A: DET S: 13 T: Proper A: DT S: 12 T: Proper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Destination Call Establishment			
		U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
6	INFOrmation	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS/C=97,S=6 S: 6 T: Inopportune A: STATUS ENQUIRY S: 6 T: Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS/C=97,S=7 S: 7 T: Inopportune A: STATUS ENQUIRY S: 7 T: Inopportune	A: STATUS/C=101,S=8 S: 8 T: Inopportune A: STATUS/C=97,S=8 S: 8 T: Inopportune A: STATUS ENQUIRY S: 8 T: Inopportune	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS/C=97,S=9 S: 9 T: Inopportune A: STATUS ENQUIRY S: 9 T: Inopportune
7	NOTIFY	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS/C=97,S=6 S: 6 T: Improper A: STATUS ENQUIRY S: 6 T: Improper/Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS/C=97,S=7 S: 7 T: Improper A: STATUS ENQUIRY S: 7 T: Improper/Inopportune	A: STATUS/C=101,S=8 S: 8 T: Inopportune A: STATUS/C=97,S=8 S: 8 T: Improper A: STATUS ENQUIRY S: 8 T: Improper/Inopportune	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS/C=97,S=9 S: 9 T: Improper A: STATUS ENQUIRY S: 9 T: Improper/Inopportune
8	PROGress	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS ENQUIRY S: 6 T: Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS ENQUIRY S: 7 T: Inopportune	A: STATUS/C=101,S=8 S: 8 T: Inopportune A: STATUS ENQUIRY S: 8 T: Inopportune	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS ENQUIRY S: 9 T: Inopportune
9	RELease	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper
10	RELease COMplete	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper
11	SETUP (Call ref. flag=0)	A: IGN S: 6 T: Inopportune	A: IGN S: 7 T: Inopportune	A: IGN S: 8 T: Inopportune	A: IGN S: 9 T: Inopportune
12	SETUP ACK	A: STATUS/C=101,S=6 S: 6 T: Inopportune A: STATUS ENQUIRY S: 6 T: Inopportune	A: STATUS/C=101,S=7 S: 7 T: Inopportune A: STATUS ENQUIRY S: 7 T: Inopportune	A: STATUS/C=101,S=8 S: 8 T: Inopportune A: STATUS ENQUIRY S: 8 T: Inopportune	A: STATUS/C=101,S=9 S: 9 T: Inopportune A: STATUS ENQUIRY S: 9 T: Inopportune
13	STATUS (cause not=30) (state = same)	A: DT S: 6 T: Proper	A: DT S: 7 T: Proper	A: DT S: 8 T: Proper	A: DT S: 9 T: Proper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Destination Call Establishment			
		U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
14	STATUS ENQUIRY	A: STATUS/C=30,S=6 S: 6 T: Proper	A: STATUS/C=30,S=7 S: 7 T: Proper	A: STATUS/C=30,S=8 S: 8 T: Proper	A: STATUS/C=30,S=9 S: 9 T: Proper
15	User Initiated Clearing	A: REL COM S: 0 T: Proper		A: DISC S: 11 T: Proper A: REL S: 19 T: Proper	
16	NO Action	A: CALL PROC S: 9 T: Proper A: CALL PROC ALERT S: 7 T: Proper A: ALERT S: 7 T: Proper A: ALERT CONN S: 8 T: Proper A: CONN S: 8 T: Proper A: CALL PROC ALERT CONNECT S: 8 T: Proper	A: CONN S: 8 T: Proper A: DT S: 7 T: Proper	A: DISC(T313 Expiry) S: 11 T: Proper	A: ALERT S: 7 T: Proper A: ALERT CONN A: CONN S: 8 T: Proper A: DT S: 9 T: Proper
17	RESTART (all interface)	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Destination Call Establishment: U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
18	RESTART (channel)	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper
19	User initiated interface restart [optional]	A: RESTART S: 0 T: Proper	A: RESTART S: 0 T: Proper	A: RESTART S: 0 T: Proper	A: RESTART S: 0 T: Proper
20	RESTART ACK	A: IGN S: 6 T: Inopportune	A: IGN S: 7 T: Inopportune	A: IGN S: 8 T: Inopportune	A: IGN S: 9 T: Inopportune
21	STATUS/ C=30,S=0	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper
34	Protocol Discriminator Error	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper	A: IGN S: 9 T: Improper
35	Message too short	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper	A: IGN S: 9 T: Improper
36	Invalid Call Reference Format (Incorrect length - 3 octets)	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper	A: IGN S: 9 T: Improper
37	Call Reference Procedural Error (Global call ref.)	A: IGN S: 6 T: Improper A: STATUS/C=81 (Global CR) S: 6 T: Improper	A: IGN S: 7 T: Improper A: STATUS/C=81 (Global CR) S: 7 T: Improper	A: IGN S: 8 T: Improper A: STATUS/C=81 (Global CR) S: 8 T: Improper	A: IGN S: 9 T: Improper A: STATUS/C=81 (Global CR) S: 9 T: Improper
38	Call Reference Procedural Error (Non-global call ref) [Note: Response is for different Call Reference]	A: REL (C=81) S: 6 T: Improper A: REL COM/C=81 S: 6 T: Improper	A: REL (C=81) S: 7 T: Improper A: REL COM/C=81 S: 7 T: Improper	A: REL (C=81) S: 8 T: Improper A: REL COM/C=81 S: 8 T: Improper	A: REL (C=81) S: 9 T: Improper A: REL COM/C=81 S: 9 T: Improper
40	Message Type Not Implemented	A: STATUS/C=97,S=6 S: 6 T: Improper A: STATUS ENQUIRY S: 6 T: Improper	A: STATUS/C=97,S=7 S: 7 T: Improper A: STATUS ENQUIRY S: 7 T: Improper	A: STATUS/C=97,S=8 S: 8 T: Improper A: STATUS ENQUIRY S: 8 T: Improper	A: STATUS/C=97,S=9 S: 9 T: Improper A: STATUS ENQUIRY S: 9 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Destination Call Establishment			
		U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
42	DISCONNECT (cause missing)	A: REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper A: STATUS/C=96,S=12(6) REL S: 19 T: Improper A: REL STATUS/C=96,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper A: STATUS/C=96,S=12(7) REL S: 19 T: Improper A: REL STATUS/C=96,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper A: STATUS/C=96,S=12(8) REL S: 19 T: Improper A: REL STATUS/C=96,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper A: STATUS/C=96,S=12(9) REL S: 19 T: Improper A: REL STATUS/C=96,S=19 S: 19 T: Improper
43	DISCONNECT (cause content error)	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(6) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(7) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(8) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(9) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Destination Call Establishment: U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
44	DISCONNECT (progress content error)	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(6) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(7) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(8) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper	A: REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: STATUS/C=100, S=12(9) REL S: 19 T: Improper A: REL STATUS/C=100,S=19 S: 19 T: Improper
46	RELease Cause missing	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper
47	RELease Cause content error	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper
48	RELease Display content error	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=6 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=7 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=8 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=100,S=9 REL COM S: 0 T: Improper
49	SETUP Bearer Cap. missing (Call ref. flag=0)	A: IGN S: 6 T: Inopportune	A: IGN S: 7 T: Inopportune	A: IGN S: 8 T: Inopportune	A: IGN S: 9 T: Inopportune
50	SETUP Bearer Cap. corrupt (Call ref. flag=0)	A: IGN S: 6 T: Inopportune	A: IGN S: 7 T: Inopportune	A: IGN S: 8 T: Inopportune	A: IGN S: 9 T: Inopportune
52	STATUS Cause missing	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=6 S: 6 T: Improper A: IGN S: 6 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=7 S: 7 T: Improper A: IGN S: 7 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=8 S: 8 T: Improper A: IGN S: 8 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=9 S: 9 T: Improper A: IGN S: 9 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Destination Call Establishment			
		U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
53	STATUS Cause content error	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=6 S: 6 T: Improper A: IGN S: 6 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=7 S: 7 T: Improper A: IGN S: 7 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=8 S: 8 T: Improper A: IGN S: 8 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=9 S: 9 T: Improper A: IGN S: 9 T: Improper
54	STATUS State missing	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=6 S: 6 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=7 S: 7 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=8 S: 8 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=9 S: 9 T: Improper
55	STATUS/C=43 State content error	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=6 S: 6 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=7 S: 7 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=8 S: 8 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=9 S: 9 T: Improper
72	RESTART (Restart Indicator missing)	A: IGN S: 6 T: Improper A: STATUS/C=96 (Global CR) S: 6 T: Improper	A: IGN S: 7 T: Improper A: STATUS/C=96 (Global CR) S: 7 T: Improper	A; IGN S: 8 T: Improper A: STATUS/C=96 (Global CR) S: 8 T: Improper	A: IGN S: 9 T: Improper A: STATUS/C=96 (Global CR) S: 9 T: Improper
73	RESTART (Restart Indicator content)	A: IGN S: 6 T: Improper A: STATUS/C=100 (Global CR) S: 6 T: Improper	A: IGN S: 7 T: Improper A: STATUS/C=100 (Global CR) S: 7 T: Improper	A: IGN S: 8 T: Improper A: STATUS/C=100 (Global CR) S: 8 T: Improper	A: IGN S: 9 T: Improper A: STATUS/C=100 (Global CR) S: 9 T: Improper
74	RESTART Channel (Channel Id. content)	A: IGN S: 6 T: Improper A: STATUS/C=100 (Global CR) S: 6 T: Improper	A: IGN S: 7 T: Improper A: STATUS/C=100 (Global CR) S: 7 T: Improper	A: IGN S: 8 T: Improper A: STATUS/C=100 (Global CR) S: 8 T: Improper	A: IGN S: 9 T: Improper A: STATUS/C=100 (Global CR) S: 9 T: Improper

Layer 3 – Primary Rate Test Matrix 2 (cont.)

<table>
<tr><th colspan="2" rowspan="2">Row No.
Message received by IUT</th><th colspan="4">Destination Call Establishment</th></tr>
<tr><th>U6
Call present
(Optional test)</th><th>U7
Call received</th><th>U8
Connect request</th><th>U9
I/C Call proceeding
(Optional test)</th></tr>
<tr><td>96</td><td>CONNect ACK IE not implemented</td><td></td><td></td><td>A: STATUS/C=99,S=10(8)
S: 10
T: Improper

A: DT
S: 10
T: Improper</td><td></td></tr>
<tr><td>97</td><td>DISCONNECT IE not implemented</td><td>A: REL
S: 19
T: Improper

A: DET
STATUS/C=99,S=13
S: 13
T: Improper

A: STATUS/C=99,S=12(6)
REL
S: 19
T: Improper

A: REL
STATUS/C=99,S=19
S: 19
T: Improper</td><td>A: REL
S: 19
T: Improper

A: DET
STATUS/C=99,S=13
S: 13
T: Improper

A: STATUS/C=99,S=12(7)
REL
S: 19
T: Improper

A: REL
STATUS/C=99,S=19
S: 19
T: Improper</td><td>A: REL
S: 19
T: Improper

A: DET
STATUS/C=99,S=13
S: 13
T: Improper

A: STATUS/C=99,S=12(8)
REL
S: 19
T: Improper

A: REL
STATUS/C=99,S=19
S: 19
T: Improper</td><td>A: REL
S: 19
T: Improper

A: DET
STATUS/C=99,S=13
S: 13
T: Improper

A: STATUS/C=99,S=12(9)
REL
S: 19
T: Improper

A: REL
STATUS/C=99,S=19
S: 19
T: Improper</td></tr>
<tr><td>98</td><td>RELease IE not implemented</td><td>A: REL COM
S: 0
T: Improper

A: STATUS/C=99
REL COM
S: 0
T: Improper</td><td>A: REL COM
S: 0
T: Improper

A: STATUS/C=99
REL COM
S: 0
T: Improper</td><td>A: REL COM
S: 0
T: Improper

A: STATUS/C=99
REL COM
S: 0
T: Improper</td><td>A: REL COM
S: 0
T: Improper

A: STATUS/C=99
REL COM
S: 0
T: Improper</td></tr>
<tr><td>99</td><td>SETUP IE not implemented (Call ref. flag=0)</td><td>A: IGN
S: 6
T: Inopportune</td><td>A: IGN
S: 7
T: Inopportune</td><td>A: IGN
S: 8
T: Inopportune</td><td>A: IGN
S: 9
T: Inopportune</td></tr>
<tr><td>100</td><td>STATUS IE not implemented (cause not=30)</td><td>A: STATUS/C=99,S=6
S: 6
T: Improper

A: DT
S: 6
T: Improper</td><td>A: STATUS/C=99,S=7
S: 7
T: Improper

A: DT
S: 7
T: Improper</td><td>A: STATUS/C=99,S=8
S: 8
T: Improper

A: DT
S: 8
T: Improper</td><td>A: STATUS/C=99,S=9
S: 9
T: Improper

A: DT
S: 9
T: Improper</td></tr>
</table>

Layer 3 – Primary Rate Test Matrix 2 (cont.)

Row No.	Message received by IUT	Destination Call Establishment			
		U6 Call present (Optional test)	U7 Call received	U8 Connect request	U9 I/C Call proceeding (Optional test)
101	STATUS ENQUIRY IE not implemented	A: STATUS/C=30,99,S=6 S: 6 T: Improper A: STATUS/C=30,S=6 S: 6 T: Improper A: STATUS/C=30,S=6 STATUS/C=99,S=6 S: 6 T: Improper A: STATUS/C=99,S=6 STATUS/C=30,S=6 S: 6 T: Improper	A: STATUS/C=30,99,S=7 S: 7 T: Improper A: STATUS/C=30,S=7 S: 7 T: Improper A: STATUS/C=30,S=7 STATUS/C=99,S=7 S: 7 T: Improper A: STATUS/C=99,S=7 STATUS/C=30,S=7 S: 7 T: Improper	A: STATUS/C=30,99,S=8 S: 8 T: Improper A: STATUS/C=30,S=8 S: 8 T: Improper A: STATUS/C=30,S=8 STATUS/C=99,S=8 S: 8 T: Improper A: STATUS/C=99,S=8 STATUS/C=30,S=8 S: 8 T: Improper	A: STATUS/C=30,99,S=9 S: 9 T: Improper A: STATUS/C=30,S=9 S: 9 T: Improper A: STATUS/C=30,S=9 STATUS/C=99,S=9 S: 9 T: Improper A: STATUS/C=99,S=9 STATUS/C=30,S=9 S: 9 T: Improper
102	STATUS/ C=30,S=0 IE not implemented	A: DT S: 0 T: Improper A: STATUS/C=95 S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS/C=95 S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS/C=95 S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS/C=95 S: 0 T: Improper (Note 3)
115	SETUP Call Ref. flag = 1	A: IGN S: 6 T: Improper	A: IGN S: 7 T: Improper	A: IGN S: 8 T: Improper	A: IGN S: 9 T: Improper

I LAYER 3 – PRIMARY RATE TEST MATRIX 3

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
1	ALERTing	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=101,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune	A: STATUS/C=101,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: DT S: 11 T: Inopportune	A: STATUS/C=101,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: DT S: 12 T: Inopportune	A: STATUS/C=101,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: DT S: 19 T: Inopportune
2	CALL PROCeeding	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 19 T: Inopportune	A: STATUS/C=101,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune	A: STATUS/C=101,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: DT S: 11 T: Inopportune	A: STATUS/C=101,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: DT S: 12 T: Inopportune	A: STATUS/C=101,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: DT S: 19 T: Inopportune

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
3	CONNect	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=101,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune	A: STATUS/C=101,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: DT S: 11 T: Inopportune	A: STATUS/C=101,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: DT S: 12 T: Inopportune	A: STATUS/C=101,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: DT S: 19 T: Inopportune
4	CONNect ACK	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=101,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune	A: STATUS/C=101,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: DT S: 11 T: Inopportune	A: STATUS/C=101,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: DT S: 12 T: Inopportune	A: DT S: 19 T: Inopportune
5	DISConnect	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: REL S: 19 T: Proper A: DT S: 12 T: Proper	A: REL S: 19 T: Proper	A: DT S: 12 T: Proper	A: DT S: 19 T: Proper

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing U11 Disc request	 U12 Disc indication (OPTIONAL)	 U 19 Release request
6	INFOrmation (Include Called Party Number)	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: DT S: 10 T: Proper A: STATUS/C=97,S=10 S: 10 T: Proper	A: DT S: 11 T: Inopportune A: STATUS/C=97,S=11 S: 11 T: Proper A: STATUS/C=101,S=11 S: 11 T: Proper A: STATUS ENQUIRY S: 11 T: Proper	A: DT S: 12 T: Inopportune A: STATUS/C=97,S=12 S: 12 T: Proper	A: DT S: 19 T: Inopportune A: STATUS/C=97,S=19 S: 19 T: Proper A: STATUS/C=101,S=19 S: 19 T: Proper A: STATUS ENQUIRY S: 19 T: Proper
7	NOTIFY	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=97,S=10 S: 10 T: Proper A: DT S: 10 T: Proper A: STATUS ENQUIRY S: 10 T: Improper	A: STATUS/C=97,S=11 S: 11 T: Proper A: DT S: 11 T: Improper/Inopportune A: STATUS/C=101,S=11 S: 11 T: Inopportune	A: STATUS/C=97,S=12 S: 12 T: Proper A: DT S: 12 T: Improper/Inopportune A: STATUS/C=101,S=12 S: 12 T: Inopportune	A: STATUS/C=97,S=19 S: 19 T: Proper A: DT S: 19 T: Improper/Inopportune A: STATUS/C=101,S=12 S: 19 T: Inopportune

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
8	PROGress	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 19 T: Inopportune	A: STATUS/C=101,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune	A: STATUS/C=101,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: DT S: 11 T: Inopportune	A: STATUS/C=101,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: DT S: 12 T: Inopportune	A: STATUS/C=101,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: DT S: 19 T: Inopportune
9	RELease	A: REL COM/C=81 S: 0 T: Proper	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper	A: REL COM S: 0 T: Proper	A: DT S: 0 T: Proper
10	RELease COM	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing U11 Disc request	Call Clearing U12 Disc indication (OPTIONAL)	Call Clearing U 19 Release request
11	SETUP(Call ref. flag=0) [Original Call to be Network generated]	A: CALL PROC S: 9 T: Proper A: ALERTING S: 7 T: Proper A: CONN S: 8 T: Proper A: CALL PROC ALERTING S: 7 T: Proper A: CALL PROC CONNECT S: 8 T: Proper A: ALERTING CONNECT S: 8 T: Proper A: CALL PROC ALERTING CONNECT S: 8 T: Proper	A: IGN S: 10 T: Inopportune	A: IGN S: 11 T: Inopportune A: REL COM S: 0 T: Inopportune	A: IGN S: 12 T: Inopportune A: REL COM S: 19 T: Inopportune	A: IGN S: 19 T: Inopportune

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing U11 Disc request	Call Clearing U12 Disc indication (OPTIONAL)	Call Clearing U 19 Release request
12	SETUP ACK	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=101,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune	A: STATUS/C=101,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: DT S: 11 T: Inopportune	A: STATUS/C=101,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: DT S: 12 T: Inopportune	A: STATUS/C=101,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: DT S: 19 T: Inopportune
13	STATUS (cause not=30) (state=same)	A: REL S: 19 T: Proper A: REL COM S: 0 T: Inopportune A: IGN S: 0 T: Proper	A: IGN S: 10 T: Proper	A: IGN S: 11 T: Proper	A: IGN S: 12 T: Proper	A: IGN S: 19 T: Proper
14	STATUS ENQUIRY	A: REL/C=81 S: 19 T: Proper A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=30,S=10 S: 10 T: Proper	A: STATUS/C=30,S=11 S: 11 T: Proper	A: STATUS/C=30,S=12 S: 12 T: Proper	A: STATUS/C=30,S=19 S: 19 T: Proper
15	User Initiated Clearing	NA	A: DISC S: 11 T: Proper A: REL S: 19 T: Proper	NA	NA	NA

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
16	NO Action	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper		A: DT S: 12 T: Proper A: REL S: 19 T: Proper	
17	RESTART (all interface)	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper
18	RESTART (channel)	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper	A: RESTART ACK S: 0 T: Proper
20	RESTART ACK	A: IGN S: 0 T: Inopportune	A: IGN S: 10 T: Inopportune	A: IGN S: 11 T: Inopportune	A: IGN S: 12 T: Inopportune	A: IGN S: 19 T: Inopportune
21	STATUS/ C=30,S=0	A: REL S: 19 T: Proper A: REL COM S: 0 T: Inopportune A: IGN S: 0 T: Inopportune	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper	A: DT S: 0 T: Proper
34	Protocol Discriminator Error	A: IGN S: 0 T: Improper	A: IGN S: 10 T: Improper	A: IGN S: 11 T: Improper	A: IGN S: 12 T: Improper	A: IGN S: 19 T: Improper
35	Message too short	A: IGN S: 0 T: Improper	A: IGN S: 10 T: Improper	A: IGN S: 11 T: Improper	A: IGN S: 12 T: Improper	A: IGN S: 19 T: Improper
36	Invalid Call Reference Format (incorrect length 3 octets)	A: IGN S: 0 T: Improper	A: IGN S: 10 T: Improper	A: IGN S: 11 T: Improper	A: IGN S: 12 T: Improper	A: IGN S: 19 T: Improper
37	Call Reference Procedural Error (Global call ref.)	A: IGN S: 0 T: Improper A: STATUS/C=81 (Global CR) S: 0 T: Improper	A: IGN S: 10 T: Improper A: STATUS/C=81 (Global CR) S: 10 T: Improper	A: IGN S: 11 T: Improper A: STATUS/C=81 (Global CR) S: 11 T: Improper	A: IGN S: 12 T: Improper A: STATUS/C=81 (Global CR) S: 12 T: Improper	A: IGN S: 19 T: Improper A: STATUS/C=81 (Global CR) S: 19 T: Improper

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing U11 Disc request	 U12 Disc indication (OPTIONAL)	 U 19 Release request
38	Call Reference Procedural Error (Non-global call ref) [Note: Response is for different Call Reference]	A: REL/C=81 S: 0 T: Improper A: REL COM/C=81 S: 0 T: Inopportune	A: REL/C=81 S: 10 T: Improper A: REL COM/C=81 S: 10 T: Inopportune	A: REL/C=81 S: 11 T: Improper A: REL COM/C=81 S: 11 T: Inopportune	A: REL/C=81 S: 12 T: Improper A: REL COM/C=81 S: 12 T: Inopportune	A: REL/C=81 S: 19 T: Improper A: REL COM/C=81 S: 19 T: Inopportune
40	Message Type Not Implemented	A: REL/C=81 S: 19 T: Improper A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=97,S=10 S: 10 T: Improper A: STATUS ENQUIRY S: 10 T: Improper	A: STATUS/C=97,S=11 S: 11 T: Improper A: STATUS ENQUIRY S: 11 T: Improper	A: STATUS/C=97,S=12 S: 12 T: Improper A: STATUS ENQUIRY S: 12 T: Improper	A: STATUS/C=97,S=19 S: 19 T: Improper A: STATUS ENQUIRY S: 19 T: Improper
41	DISConnect Cause missing		A: REL STATUS/C=96,S=19 S: 19 T: Improper A: STATUS/C=96,S=10 REL S: 19 T: Improper A: DET STATUS/C=96,S=13 S: 13 T: Improper A: REL S: 19 T: Improper	A: REL STATUS/C=96,S=19 S: 19 T: Improper A: STATUS/C=96,S=19 REL S: 19 T: Improper A: REL S: 19 T: Improper		
42	DISConnect Cause content error		A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100,S=10 REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: REL S: 19 T: Improper	A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100,S=11 REL S: 19 T: Improper A: REL S: 19 T: Improper		

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
43	DISConnect Progress content error		A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100,S=10 REL S: 19 T: Improper A: DET STATUS/C=100,S=13 S: 13 T: Improper A: REL S: 19 T: Improper	A: REL STATUS/C=100,S=19 S: 19 T: Improper A: STATUS/C=100,S=11 REL S: 19 T: Improper A: REL S: 19 T: Improper		
46	INFOrmation Display missing		A: STATUS/C=96,S=10 S: 10 T: Improper A: STATUS/C=97,S=10 S: 10 T: Improper			
48	PROGRESS Progress missing	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C= ,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune A: STATUS/C= ,S=10 STATUS/C= ,S=10 S: 10 T: Improper/Inopportune	A: STATUS/C= ,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: STATUS/C= ,S=11 STATUS/C= ,S=11 S: 11 T: Improper/Inopportune A: IGN S: 11 T: Inopportune	A: STATUS/C= ,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: STATUS/C= ,S=12 STATUS/C= ,S=12 S: 12 T: Improper/Inopportune A: IGN S: 12 T: Inopportune	A: STATUS/C= ,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: STATUS/C= ,S=19 STATUS/C= ,S=19 S: 19 T: Improper/Inopportune A: IGN S: 19 T: Inopportune

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
49	PROGRESS Progress content error	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C= ,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune A: STATUS/C= ,S=10 STATUS/C= ,S=10 S: 10 T: Improper/Inopportune	A: STATUS/C= ,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: STATUS/C= ,S=11 STATUS/C= ,S=11 S: 11 T: Improper/Inopportune A: IGN S: 11 T: Inopportune	A: STATUS/C= ,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: STATUS/C= ,S=12 STATUS/C= ,S=12 S: 12 T: Improper/Inopportune A: IGN S: 12 T: Inopportune	A: STATUS/C= ,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: STATUS/C= ,S=19 STATUS/C= ,S=19 S: 19 T: Improper/Inopportune A: IGN S: 19 T: Inopportune
51	RELease Cause missing	A: REL COM S: 0 T: Inopportune	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM/C=96 S: 0 T: Improper A: DT S: 0 T: Improper (Note 3)
52	RELease Cause content error	A: REL COM S: 0 T: Inopportune	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM/C=100 S: 0 T: Improper A: DT S: 0 T: Improper (Note 3)
53	RELease Display content error	A: REL COM S: 0 T: Inopportune	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper	A: REL COM/C=100 S: 0 T: Improper A: DT S: 0 T: Improper (Note 3)
55	REL COMplete Cause missing	A: DT S: 0 T: Inopportune				A: DT S: 0 T: Improper

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
56	REL COMplete Cause content error	A: DT S: 0 T: Inopportune				A: DT S: 0 T: Improper
58	SETUP Bearer cap. missing (Call ref. flag=0)	A: REL COM/C=96 S: 0 T: Improper				
59	SETUP Bearer cap.cont err (Call ref. flag=0)	A: REL COM/C=100 S: 0 T: Improper				
60	SETUP Channel Id. missing (Call ref. flag=0)	A: REL COM/C=96 S: 0 T: Improper				
61	SETUP Channel Id.cont err (Call ref. Flag=0)	A: REL COM/C=100 S: 0 T: Improper				

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
62	SETUP Prog. Ind.cont err (Call ref. flag=0)	A: REL COM/C=100 S: 0 T: Improper A: STATUS/C=100, S=0 ALERTING S: 7 T: Improper A: ALERTING STATUS/C=100, S=7 S: 7 T: Improper A: ALERTING S: 7 T: Improper A: STATUS/C=100, S=0 CALL PROC. S: 9 T: Improper A: CALL PROC. STATUS/C=100, S=9 S: 9 T: Improper A: CALL PROC. S: 9 T: Improper A: STATUS/C=100, S=0 CONNECT S: 8 T: Improper A: CONNECT STATUS/C=100, S=8 S: 8 T: Improper A: CONNECT S: 8 T: Improper A: CALL PROC ALERTING S: 7 T: Improper A: CALL PROC ALERTING CONNECT S: 8 T: Proper				

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
62 Cont.	SETUP Prog. Ind.cont err (Call ref. flag=0)	A: ALERTING CONNECT S: 8 T: Proper A: CALL PROC CONNECT S: 8 T: Proper				
63	SETUP Display cont err (Call ref. flag=0)	[see Row 62]				
64	SETUP Calling party number cont err (Call ref. flag=0)	[see Row 62]				
65	SETUP Calling party subaddress cont err (Call ref. flag=0)	[see Row 62]				
66	SETUP Called party number cont error (Call ref. flag=0)	[see Row 62]				
67	SETUP Called party subaddress con error (Call ref. flag=0)	[see Row 62]				
68	SETUP Low layer compat. cont error (Call ref. flag=0)	[see Row 62]				
69	SETUP high layer compat. cont error (Call ref. flag=0)	[see Row 62]				

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
71	SETUP Teleservice type content error (Call ref. flag=0)	A: REL COM/C=99(100) (88) S: 0 T: Improper A: CALL PROC. REL COM/C=88 S: 0 T: Improper A: STATUS/C=99(100), S=0 ALERTING S: 7 T: Improper A: ALERTING STATUS/C=99(100), S=7 S: 7 T: Improper A: STATUS/C=99(100), S=0 CALL PROC. S: 9 T: Improper A: CALL PROC. STATUS/C=99(100), S= 9 S: 9 T: Improper A: STATUS/C=99(100), S=0 CONNECT S: 8 T: Improper A: CONNECT STATUS/C=99(100, S=8 S: 8 T: Improper A: CALL PROC. ALERTING S: 7 T: Improper A: CALL PROC ALERTING CONNECT S: 8 T: Proper				

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
72	STATUS Cause missing		A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=10 S: 10 T: Improper A: IGN S: 10 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=11 S: 11 T: Improper A: IGN S: 11 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=12 S: 12 T: Improper A: IGN S: 12 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=19 S: 19 T: Improper A: IGN S: 19 T: Improper
73	STATUS Cause content error		A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=10 S: 10 T: Improper A: IGN S: 10 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=11 S: 11 T: Improper A: IGN S: 11 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=12 S: 12 T: Improper A: IGN S: 12 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=19 S: 19 T: Improper A: IGN S: 19 T: Improper
74	STATUS State missing		A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=10 S: 10 T: Improper A: IGN S: 10 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=11 S: 11 T: Improper A: IGN S: 11 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=12 S: 12 T: Improper A: IGN S: 12 T: Improper	A: REL/C=96 S: 19 T: Improper A: STATUS/C=96,S=19 S: 19 T: Improper A: IGN S: 19 T: Improper
75	STATUS State content error		A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=10 S: 10 T: Improper A: REL/C=101 S: 19 T: Improper A: IGN S: 10 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=11 S: 11 T: Improper A: REL/C=101 S: 19 T: Improper A: IGN S: 11 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=12 S: 12 T: Improper A: REL/C=101 S: 19 T: Improper A: IGN S: 12 T: Improper	A: REL/C=100 S: 19 T: Improper A: STATUS/C=100,S=19 S: 19 T: Improper A: REL/C=101 S: 19 T: Improper A: IGN S: 19 T: Improper

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing U11 Disc request	Call Clearing U12 Disc indication (OPTIONAL)	Call Clearing U 19 Release request
91	RESTART Restart indicator missing	A: IGN S: 0 T: Improper A: STATUS/C=96 (Global CR) S: 0 T: Improper	A: IGN S: 10 T: Improper A: STATUS/C=96 (Global CR) S: 10 T: Improper	A: IGN S: 11 T: Improper A: STATUS/C=96 (Global CR) S: 11 T: Improper	A: IGN S: 12 T: Improper A: STATUS/C=96 (Global CR) S: 12 T: Improper	A: IGN S: 19 T: Improper A: STATUS/C=96 (Global CR) S: 19 T: Improper
92	RESTART Restart indicator content error	A: IGN S: 0 T: Improper A: STATUS/C=100 S: 0 T: Improper	A: IGN S: 10 T: Improper A: STATUS/C=100 S: 10 T: Improper	A: IGN S: 11 T: Improper A: STATUS/C=100 S: 11 T: Improper	A: IGN S: 12 T: Improper A: STATUS/C=100 S: 12 T: Improper	A: IGN S: 19 T: Improper A: STATUS/C=100 S: 19 T: Improper
93	RESTART (Channel restart) Channel Id. content error	A: IGN S: 0 T: Improper A: STATUS/C=100 S: 0 T: Improper	A: IGN S: 10 T: Improper A: STATUS/C=100 S: 10 T: Improper	A: IGN S: 11 T: Improper A: STATUS/C=100 S: 11 T: Improper	A: IGN S: 12 T: Improper A: STATUS/C=100 S: 12 T: Improper	A: IGN S: 19 T: Improper A: STATUS/C=100 S: 19 T: Improper
118	DISConnect IE not implemented		A: REL S: 19 T: Improper A: REL STATUS/C=99,S=19 S: 19 T: Improper A: STATUS/C=99,S=10 (12) REL S: 19 T: Improper	A: REL S: 19 T: Improper A: REL STATUS/C=99,S=19 S: 19 T: Improper A: STATUS/C=99,S=11 (12) REL S: 19 T: Improper		
119	INFOrmation IE not implemented		A: STATUS/C=99,S=10 S: 10 T: Improper A: STATUS/C=97,S=10 S: 10 T: Improper A: DT S: 10 T: Improper			

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
120	NOTIFY IE not implemented		A: STATUS/C=99,S=10 S: 10 T: Improper A: STATUS/C=97,S=10 S: 10 T: Improper A: DT S: 10 T: Improper			
121	PROGRESS IE not implemented	A: REL/C=81 S: 19 T: Inopportune A: REL COM/C=81 S: 0 T: Inopportune	A: STATUS/C=101,S=10 S: 10 T: Inopportune A: STATUS ENQUIRY S: 10 T: Inopportune	A: STATUS/C=101,S=11 S: 11 T: Inopportune A: STATUS ENQUIRY S: 11 T: Inopportune A: DT S: 11 T: Inopportune	A: STATUS/C=101,S=12 S: 12 T: Inopportune A: STATUS ENQUIRY S: 12 T: Inopportune A: DT S: 12 T: Inopportune	A: STATUS/C=101,S=19 S: 19 T: Inopportune A: STATUS ENQUIRY S: 19 T: Inopportune A: DT S: 19 T: Inopportune
122	RELease IE not implemented		A: REL COM S: 0 T: Improper A: STATUS/C=99,S=10 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=99,S=11 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS/C=99,S=12 REL COM S: 0 T: Improper	A: REL COM S: 0 T: Improper A: STATUS REL COM S: 0 T: Improper A: STATUS S: 0 T: Improper A: DT S: 0 T: Improper (Note 3)

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing U11 Disc request	 U12 Disc indication (OPTIONAL)	 U 19 Release request
123	SETUP IE not implemented (Call ref. flag=0)	A: STATUS/C=99, S=0 ALERTING S: 7 T: Improper A: ALERTING STATUS/C=99, S=7 S: 7 T: Improper A: ALERTING S: 7 T: Improper A: STATUS/C=99, S=0 CALL PROC. S: 9 T: Improper A: CALL PROC. STATUS/C=99, S=9 S: 9 T: Improper A: CALL PROC. S: 9 T: Improper A: STATUS/C=99, S=0 CONNECT S: 8 T: Improper A: CONNECT STATUS/C=99, S=8 S: 8 T: Improper A: CONNECT S: 8 T: Improper A: CALL PROC. ALERTING S: 7 T: Improper				

Layer 3 – Primary Rate Test Matrix 3 (cont.)

Row No.	Message received by IUT	U0 Null	U10 Active	Call Clearing		
				U11 Disc request	U12 Disc indication (OPTIONAL)	U 19 Release request
124	STATUS IE not implemented (cause not=30) state=same		A: STATUS/C=99,S=10 S: 10 T: Improper A: DT S: 10 T: Improper	A: STATUS/C=99,S=11 S: 11 T: Improper A: DT S: 11 T: Improper	A: STATUS/C=99,S=12 S: 12 T: Improper A: DT S: 12 T: Improper	A: STATUS/C=99,S=19 S: 19 T: Improper A: DT S: 19 T: Improper
125	STATUS ENQUIRY IE not implemented		A: STAT/C=30,99,S=10 S: 10 T: Improper A: STATUS/C=30,S=10 STATUS/C=99,S=10 S: 10 T: Improper A: STATUS/30,S=10 S: 10 T: Improper	A: STAT/C=30,99,S=11 S: 11 T: Improper A: STATUS/C=30,S=11 STATUS/C=99,S=11 S: 11 T: Improper A: STATUS/30,S=11 S: 11 T: Improper	A: STAT/C=30,99,S=12 S: 12 T: Improper A: STATUS/C=30,S=12 STATUS/C=99,S=12 S: 12 T: Improper A: STATUS/30,S=12 S: 12 T: Improper	A: STAT/C=30,99,S=19 S: 19 T: Improper A: STATUS/C=30,S=19 STATUS/C=99,S=19 S: 19 T: Improper A: STATUS/30,S=19 S: 19 T: Improper
126	RESTART IE not implemented	A: RESTART ACK S: 0 T: Improper A: STATUS/C=99 RESTART ACK S: 0 T: Improper	A: RESTART ACK S: 0 T: Improper A: STATUS/C=99 RESTART ACK S: 0 T: Improper A: DT S: 10 T: Improper	A: RESTART ACK S: 0 T: Improper A: STATUS/C=99 RESTART ACK S: 0 T: Improper	A: RESTART ACK S: 0 T: Improper A: STATUS/C=99 RESTART ACK S: 0 T: Improper	A: RESTART ACK S: 0 T: Improper A: STATUS/C=99 RESTART ACK S: 0 T: Improper
127	STATUS/ C=30,S=0 IE not implemented		A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)	A: DT S: 0 T: Improper A: STATUS S: 0 T: Improper (Note 3)

J LAYER 3 – PRIMARY RATE TEST MATRIX 4

Tester does not send a test message	Test State (user initialised to this state at time = 0					
	U1	U2	U3	U8	U11	U19
First Expiry	A: SETUP S: 1 A: DT S: 1 Timer T303 = 4s (Optional Timer)	A: DISC S: 11 A: DT S: 2 Timer T304 = 15s (Optional Timer)	A: DISC S: 11 A: DT S: 3 Timer T310 = 10s (Optional Timer)	A: DISC S: 11 Timer T313 = 4s	A: REL S: 19 Timer T305 = 30s	A: REL S: 19 Timer T308 = 4s
Second Expiry (These responses include First Expiry Response)	A: Setup REL COM S: 0 A: DT S: 1 T = T303 x2 = 8s					A: REL RESTART (Channel) [Note 1] S: 0 T= T308 x2 = 8s

Note 1: The Channel Restart on the 2nd Expiry of T308 is Optional.

Note 2: The acceptable tolerance for each timer is as follows:

T303 Minimum 3 sec, Maximum 5 sec
T304 Minimum 14 sec, Maximum 16 sec
T305 Minimum 28 sec, Maximum 32 sec
T308 Minimum 3 sec, Maximum 5 sec
T310 Minimum 9 sec, Maximum 11 sec
T313 Minimum 3 sec, Maximum 5 sec

K LAYER 3 – INITIALISATION SEQUENCES FOR ALL USER STATES

The following initialisation sequences are provided as a guide to create appropriate preambles. They are not an exhaustive list but represent a small subset of possible sequences. Note that some of the indicated sequences may be difficult to attain depending on the capabilities of the SUT. If a user interface cannot be initialised to a particular state, then all tests in that test group will be abandoned and FAILED.

INITIALISATION TO NULL STATE (U0)	
User states (Terminal) →	**Network (Tester)** ←
U0, U1, U2, U3, U4, U6, U7, U8, U9, U10, U11, U12, U19	
	RELEASE ←
RELEASE COMP →	
U0	
OR	
U0, U1	
	RELEASE COMP ←
U0	

INITIALISATION TO CALL INIT STATE (U1)	
User states (Terminal) →	**Network (Tester)** ←
U0	
SETUP →	
(Manually triggered)	
U1	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

INITIALISATION TO OVERLAP SENDING STATE (U2)	
User states (SUT) →	**Network (Tester)** ←
U0 SETUP → (Manually triggered) U1 U2	 SETUP ACK ←

INITIALISATION TO OUTGOING CALL PROCEEDING STATE (U3)	
User states (SUT) →	**Network (Tester)** ←
U0 SETUP → (Manually triggered) U1 U3	 CALL PROCEEDING ←
OR	
U0 SETUP → (Manually triggered) U2 U3	 SETUP ACK ← CALL PROCEEDING ←

Layer 3 – Primary Rate Test Matrix 3 (cont.)

INITIALISATION TO CALL DELIVERED STATE (U4)	
User states (SUT)	**Network (Tester)**
U0 SETUP (Manually triggered) U1 U2 U4	 SETUP ACK ALERTING
OR	
U0 SETUP (Manually triggered) U1 U3 U4	 CALL PROCEEDING ALERTING
OR	
U0 SETUP (Manually triggered) U1 U2 U3 U4	 SETUP ACK CALL PROCEEDING ALERTING

Layer 3 – Primary Rate Test Matrix 3 (cont.)

INITIALISATION TO ACTIVE STATE (U10) – FOR OUTGOING CALLS	
User states (SUT) ⟶	**Network (Tester)** ⟵
U0 SETUP ⟶ (Manually triggered) U1	
	SETUP ACK ⟵
U2 ⟶ INFO ⟶ INFO	
: : : : : etc : : :	(Until adequate information received)
	CONNECT ⟵
CONNECT ACK (Optional) ⟶ U10	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

OR	
U0	
SETUP →	
(Manually triggered)	
U1	
	SETUP ACK ←
U2	
INFO →	
INFO →	
: :	
: :	(Until adequate information received)
: etc :	
: :	
	CALL PROCEEDING ←
U3	
	CONNECT ←
CONNECT ACK (Optional) →	
U10	

OR	
U0	
SETUP	
(Manually triggered)	
U1	
	SETUP ACK ←
U2	
INFO →	
INFO →	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

: :	
: etc :	(Until adequate information received)
: :	
	ALERTING ←
U4	
	CONNECT ←
CONNECT ACK (Optional) →	
U10	

OR	
U0	
SETUP →	
(Manually triggered)	
U1	
	SETUP ACK ←
U2	
INFO →	
INFO →	
: :	
: etc :	(Until adequate information received)
: :	
	CALL PROCEEDING ←
U3	
	ALERTING ←
	CONNECT ←
U4	
CONNECT ACK (Optional) →	
U10	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

OR	
U0 SETUP ——→ (Manually triggered) U1	
	CALL PROCEEDING ←——
U3	
	CONNECT ←——
CONNECT ACK (Optional) ——→ U10	

OR	
U0 SETUP ——→ (Manually triggered) U1	
	CALL PROCEEDING ←——
U3	
	ALERTING ←——
U4	
	CONNECT ←——
CONNECT ACK (Optional) ——→ U10	

INITIALISATION TO CALL PRESENT STATE (U6) — Testing in State 6 is OPTIONAL	
User states (SUT) ——→	**Network (Tester)** ←——
U0	
	SETUP ←——
U6	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

INITIALISATION TO CALL RECEIVED STATE (U7)	
User states (SUT) →	**Network (Tester)** ←
U0	
	SETUP ←
U6	
ALERTING →	
U7	
OR	
U0	
	SETUP ←
U6	
CALL PROCEEDING →	
U9	
ALERTING →	
U7	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

INITIALISATION TO CONNECT REQUEST STATE (U8)	
User states (SUT) →	**Network (Tester)** ←
U0	
	SETUP ←
U6	
CONNECT →	
U8	
OR	
U0	
	SETUP ←
U6	
ALERTING →	
U7	
CONNECT →	
U8	
OR	
U0	
	SETUP ←
U6	
CALL PROCEEDING →	
U9	
CONNECT →	
U8	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

OR	
U0	
	SETUP ←
U6	
CALL PROCEEDING →	
U9	
ALERTING →	
U7	
CONNECT →	
U8	

INITIALISATION TO INCOMING CALL PROCEEDING STATE (U9)	
User states (SUT) →	**Network (Tester)** ←
U0	
	SETUP ←
U6	
CALL PROCEEDING →	
U9	

Note: If the SUT does not send CALL PROCEEDING then testing in this state is not mandatory.

INITIALISATION TO ACTIVE STATE (U10) – FOR INCOMING CALLS	
User states (SUT) →	**Network (Tester)** ←
U0	
	SETUP ←
U6	
CONNECT →	
	CONNECT ACK ←
U9	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

OR	
U0	
	SETUP
	←
U6	
ALERTING	
→	
U7	
CONNECT	
→	
U8	
	CONNECT ACK
	←
U10	

OR	
U0	
	SETUP
	←
U6	
CALL PROCEEDING	
→	
U9	
CONNECT	
→	
U8	
	CONNECT ACK
	←
U10	

OR	
U0	
	SETUP
	←
U6	
CALL PROCEEDING	
→	
U9	
ALERTING	
U7	
→	
CONNECT	
→	

Layer 3 – Primary Rate Test Matrix 3 (cont.)

U8 U10	CONNECT ACK ←———

INITIALISATION TO DISCONNECT REQUEST STATE (U11)	
User states (SUT) ———→	**Network (Tester)** ←———
U1, U2, U3, U4, U10 DISCONNECT (Manually triggered) ———→ U11	
OR	
U8 (No action) (Expiry T313) DISCONNECT ———→ U11	
OR	
U2 (No action) (Expiry T304 if implemented) DISCONNECT ———→ U11	

INITIALISATION TO DISCONNECT INDICATION STATE (U12)	
User states (SUT) ———→	**Network (Tester)** ←———
U1, U2, U3, U4, U10 U12	DISCONNECT ←———

Layer 3 – Primary Rate Test Matrix 3 (cont.)

INITIALISATION TO RELEASE REQUEST STATE (U19)	
User states (SUT) →	**Network (Tester)** ←
U1, U2, U3, U4, U10, U12 RELEASE (Manually triggered) → U19	
OR	
U11 RELEASE → U19	DISCONNECT ←
OR	
U11 (No action) RELEASE (Expiry T305) → U19	
OR	
U10 RELEASE (Missing call state IE) → U19	STATUS ←

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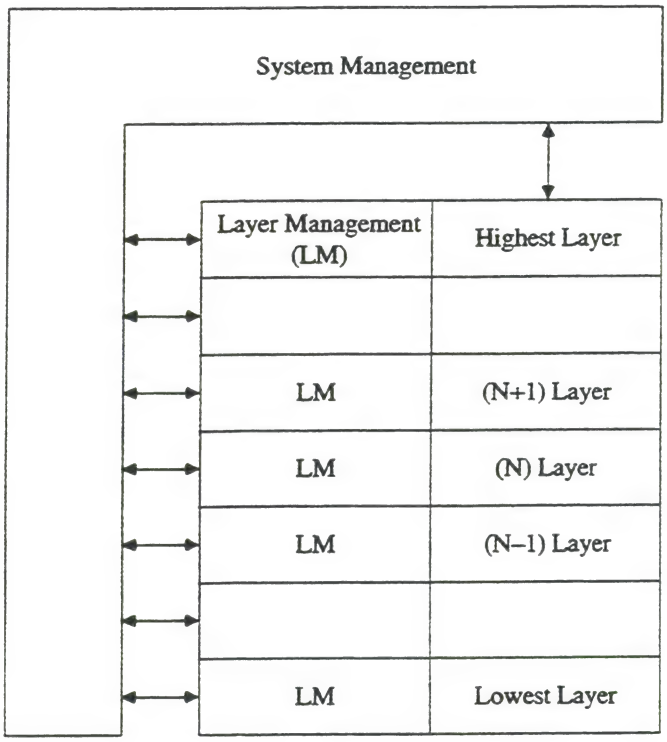


Figure 1

Layering

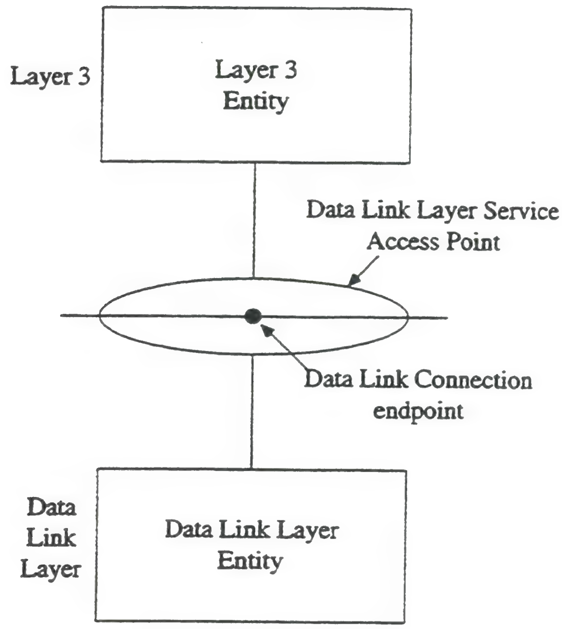


Figure 2

Entities, Service Access Points and Endpoints

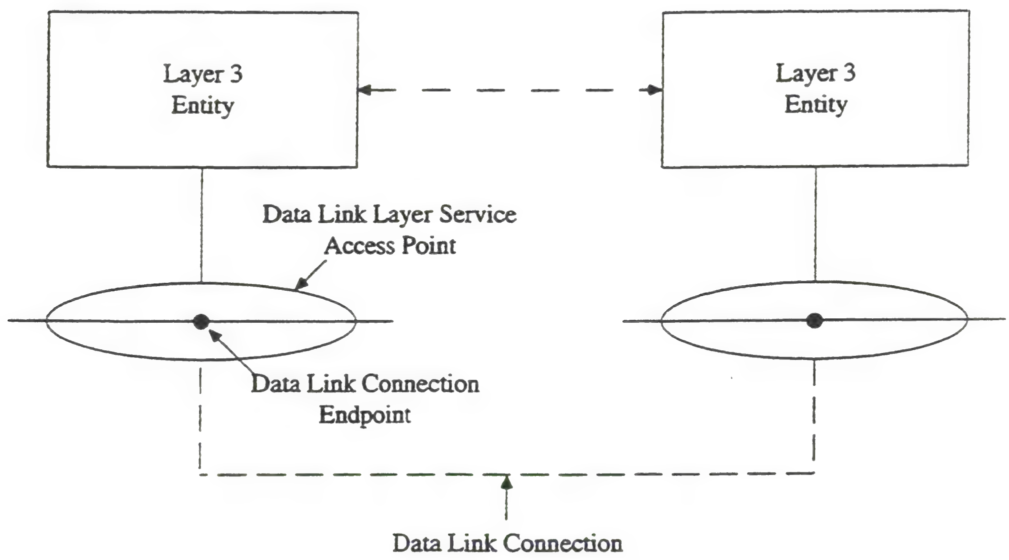
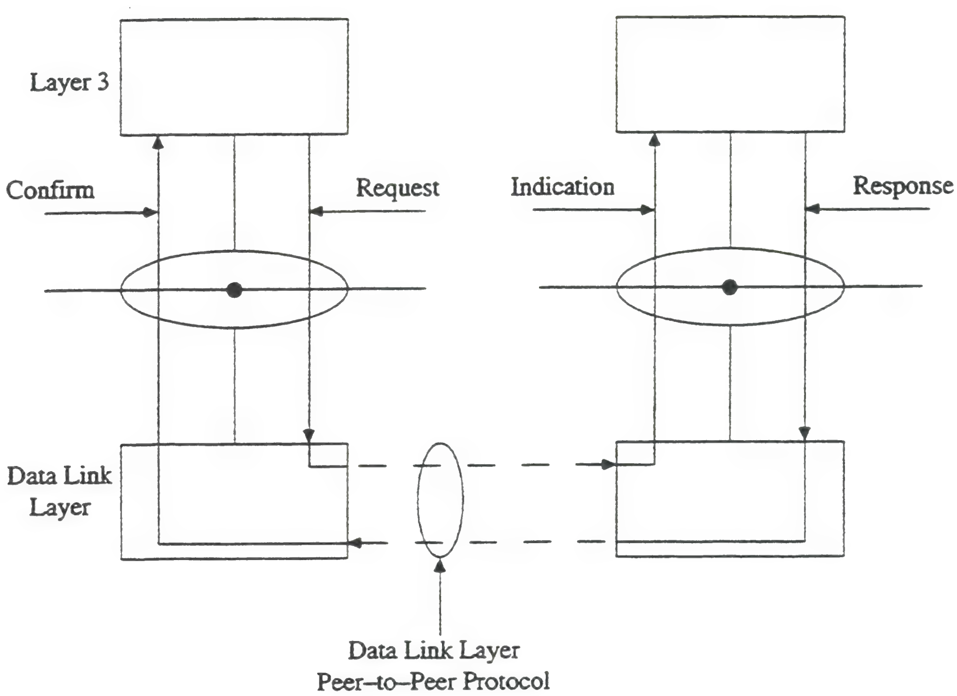


Figure 3

Peer–to–Peer Relationship



Note: The same priniciple applies for data link layer – physical layer interactions

Figure 4

Primitive Action Sequence

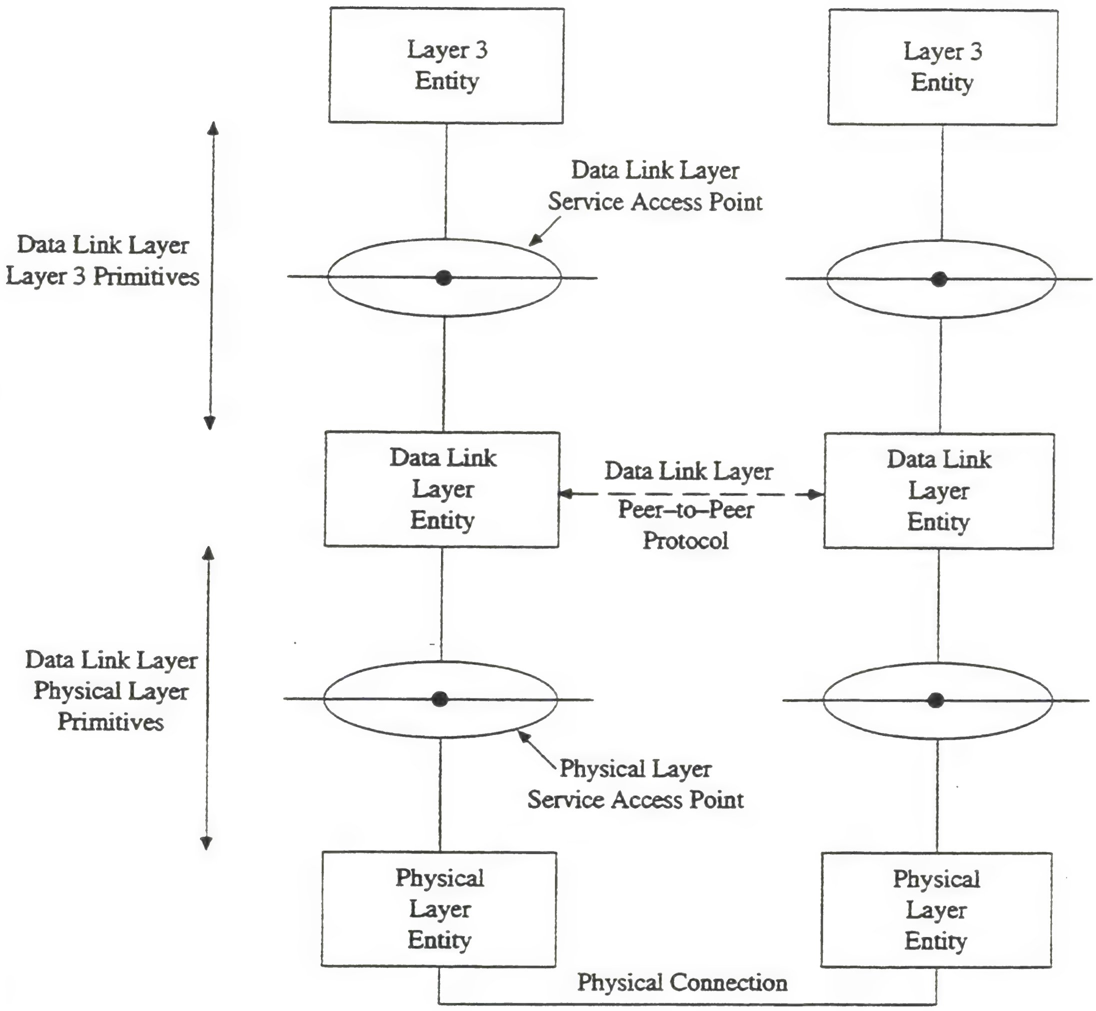


Figure 5

Data Link Layer Reference Model

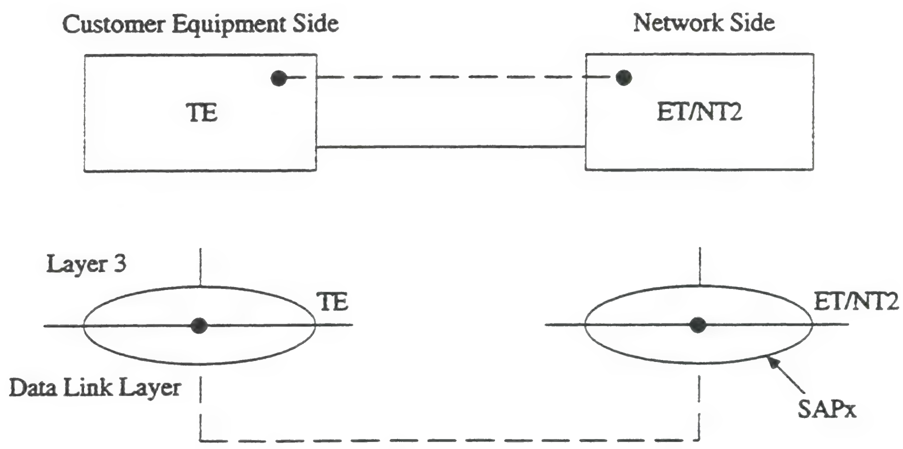


Figure 6

Point–to–Point Data Link Connections

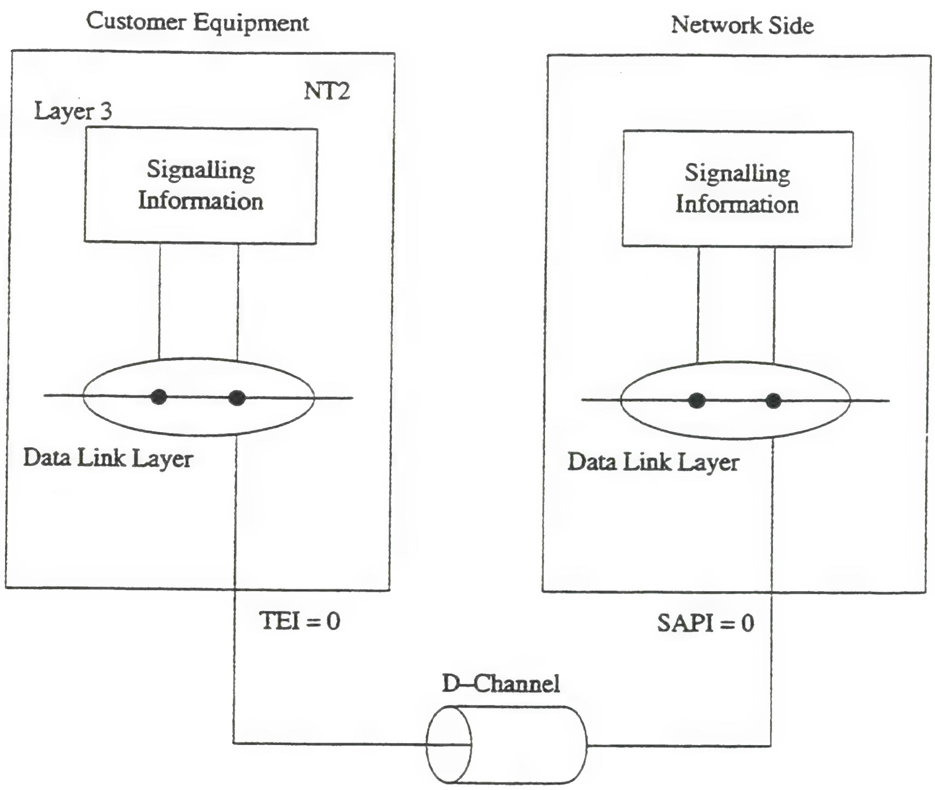
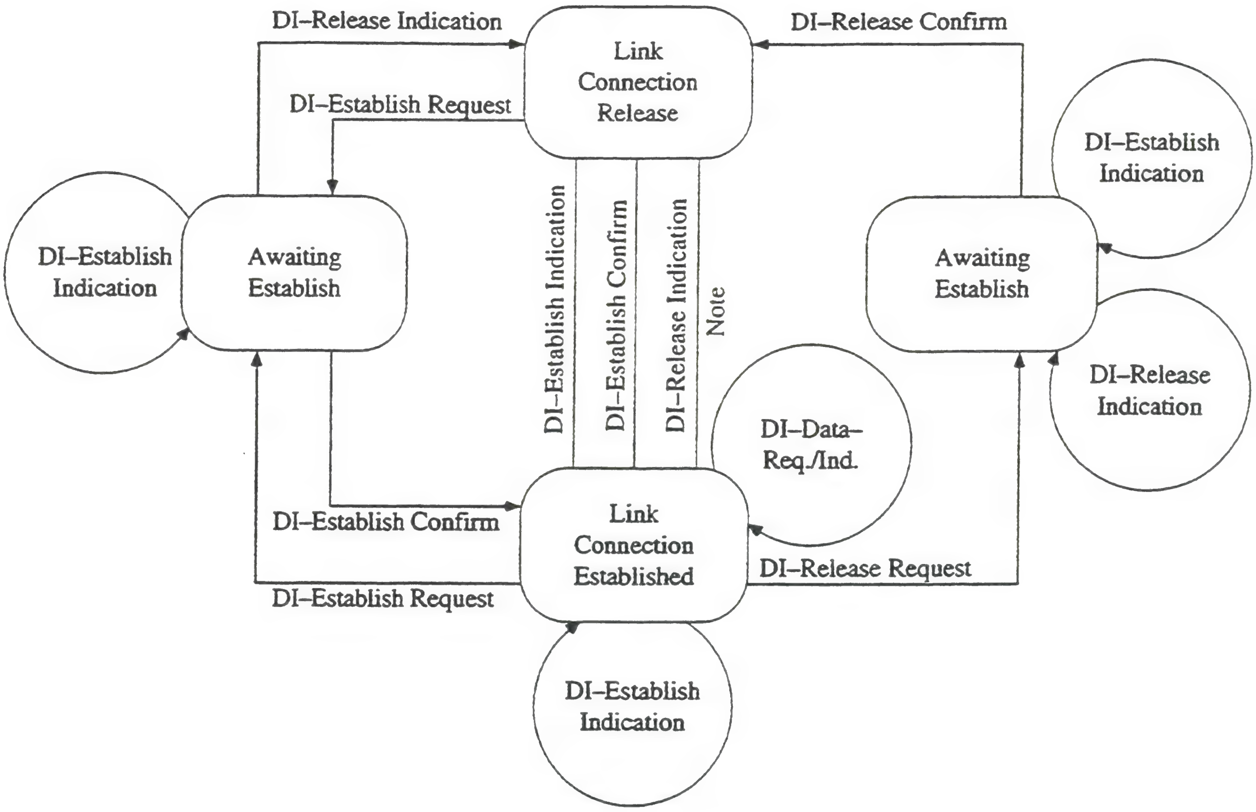


Figure 7

Overview description of the relationship between SAPI, TEI and DLCI



Note: Possible loss of information

Note 1: If the data link layer entity issues a DL–ESTABLISH–INDICATION (this applies to the case of data link layer initiated or peer system initiated re–establishment), DL–RELEASE–CONFIRM or DL–RELEASE–INDICATION, this indicates the discard of all the data link service data units representing DL–DATA–REQUEST.

Note 2: This primitive notifies to layer 3 link re–establishment.

Note 3: This primitive will occur if a DL–RELEASE–REQUEST collides with a DL–RELEASE–INDICATION.

Note 4: This primitive will occur if a DL–ESTABLISH–REQUEST collides with a DL–ESTABLISH–INDICATION.

Note 5: This primitive will occur if a DL–RELEASE–REQUEST collides with a DL–ESTABLISH–INDICATION.

Note 6: This primitive will occur if a DL–ESTABLISH–REQUEST (this applies to the case of layer 3 initiated re–establishment) collides with a DL–RELEASE–INDICATION. Since this DL–RELEASE–INDICATION is not related to the DL–ESTABLISH–REQUEST, the data link layer will establish the link and issue a DL–ESTABLISH–CONFIRM.

Figure 8

State Transition Diagram for Sequence of Primitives at a Point–to–Point Data Link Connection Endpoint as Seen by Layer 3

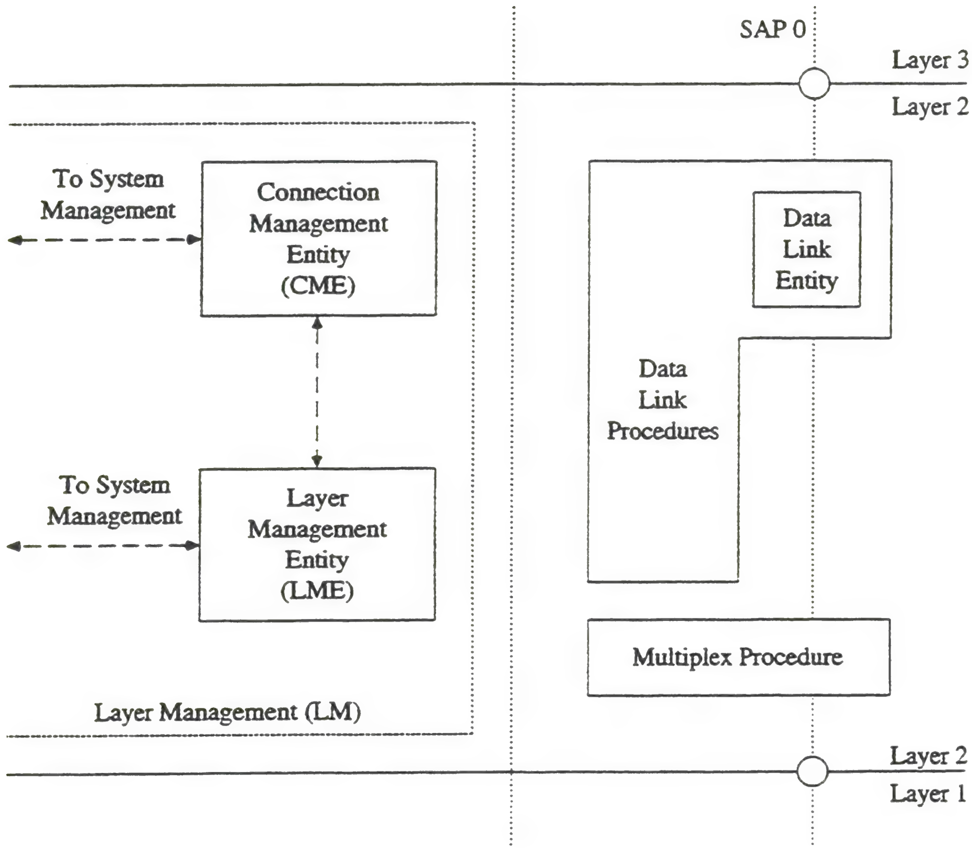


Figure 9

Functional Model of the Data Link–Management Layer

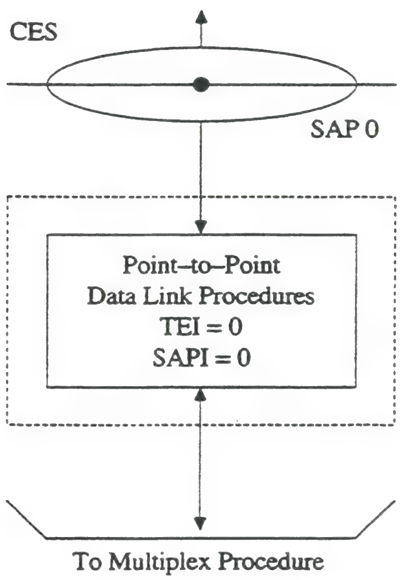


Figure 10

Data Link Procedure Structure

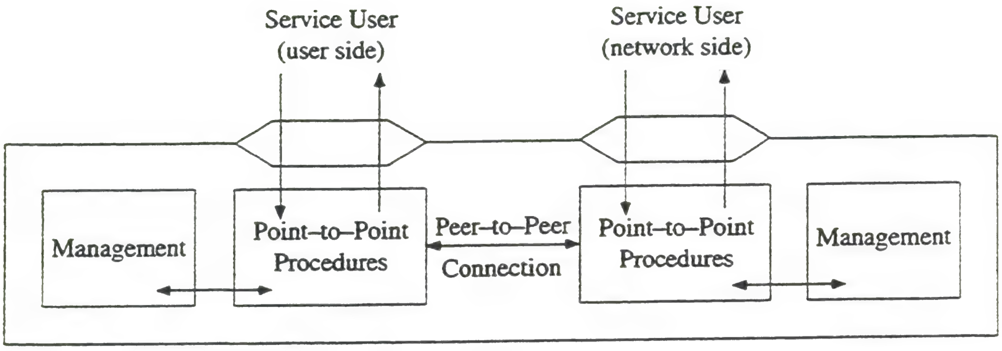


Figure 11

Peer–to–Peer Model of the Point–to–Point Procedures

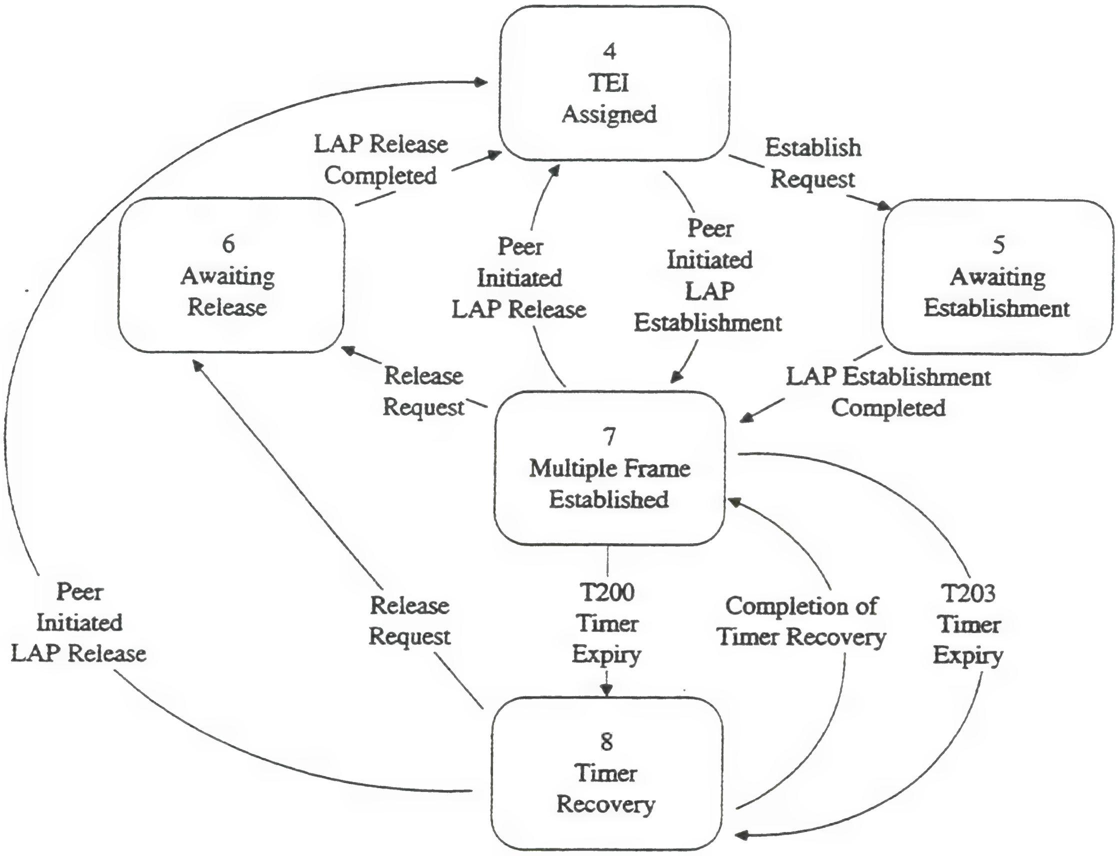
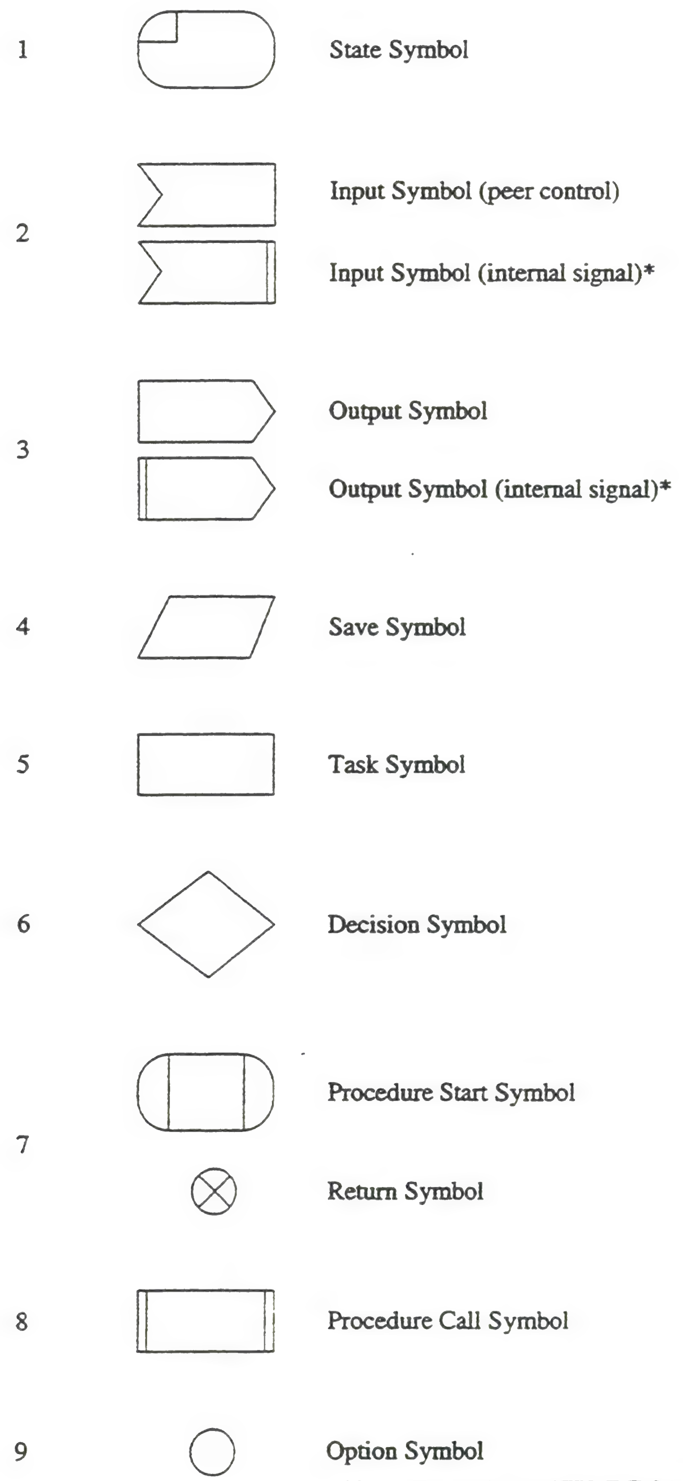


Figure 12

An Overview of the States of the Point–to–Point Procedures



* Not included in the ITU–T Z Series Recommendations [88].

Figure 13

Legend for Figure 14 SDL Sequence Diagrams

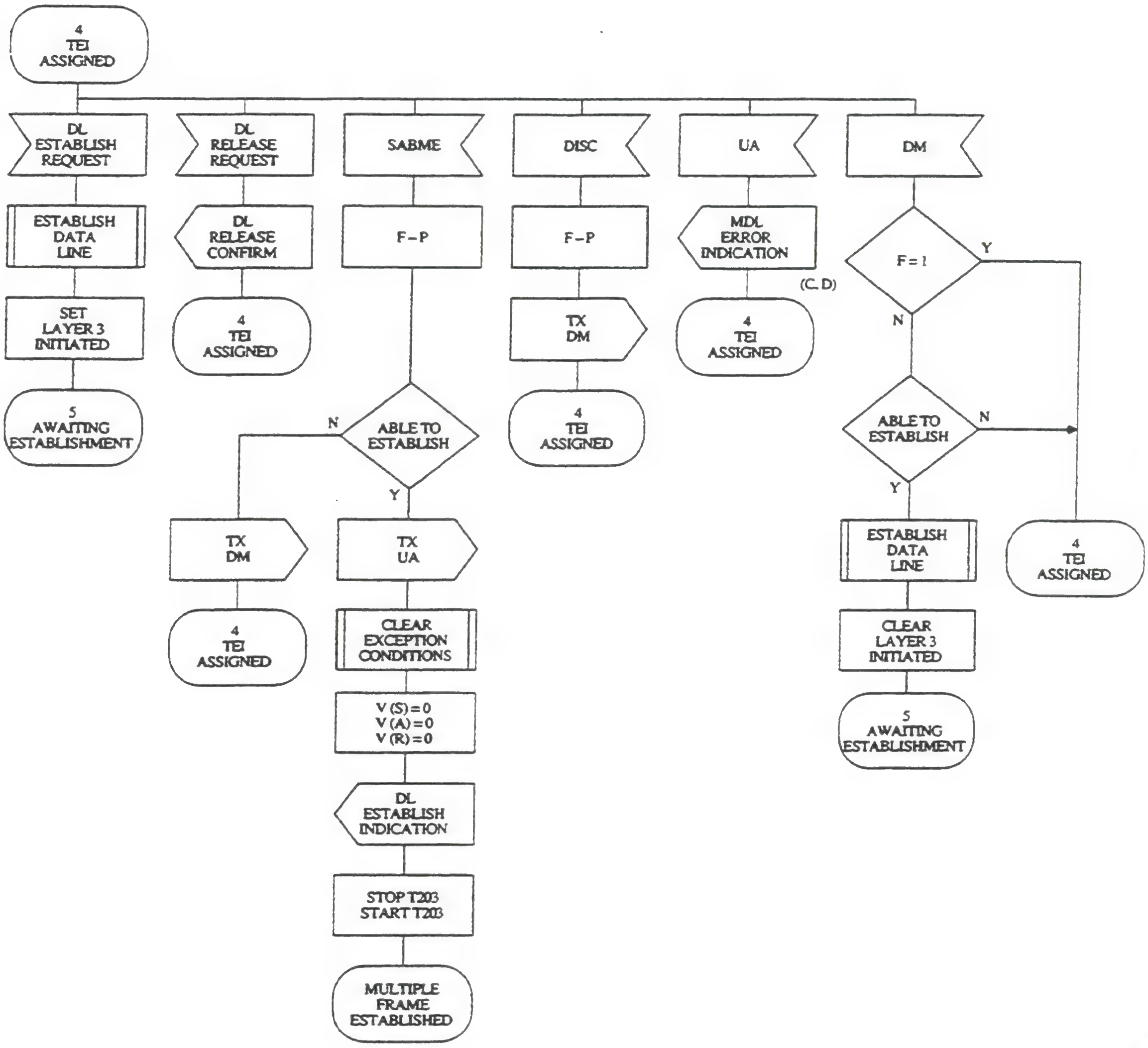
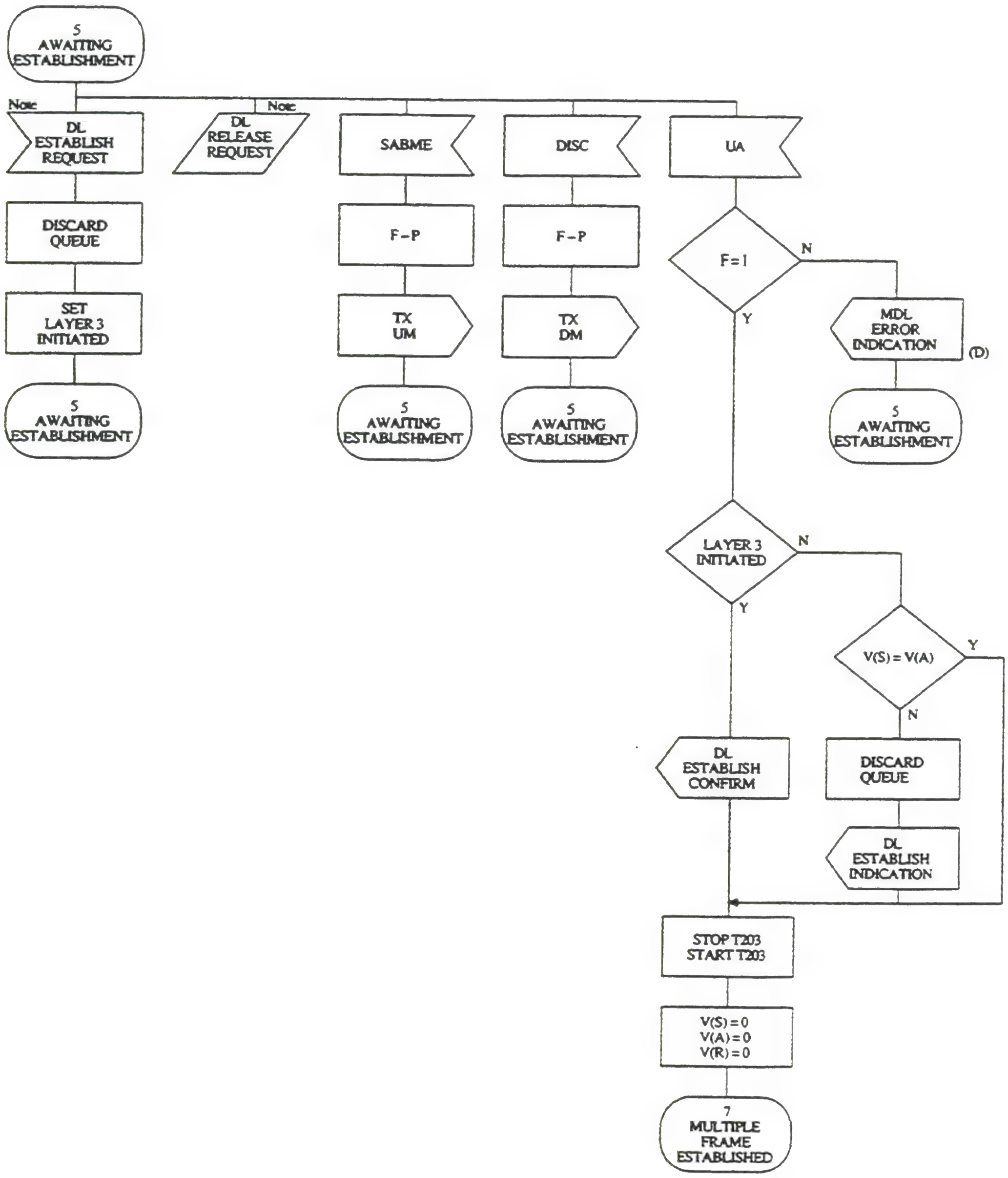


Figure 14

SDL Sequence Diagrams (Sheet 1of 20)



Note: Only possible in cases of Layer 2 initiated re–establishment

Figure 14

SDL Sequence Diagrams (Sheet 2 of 20)

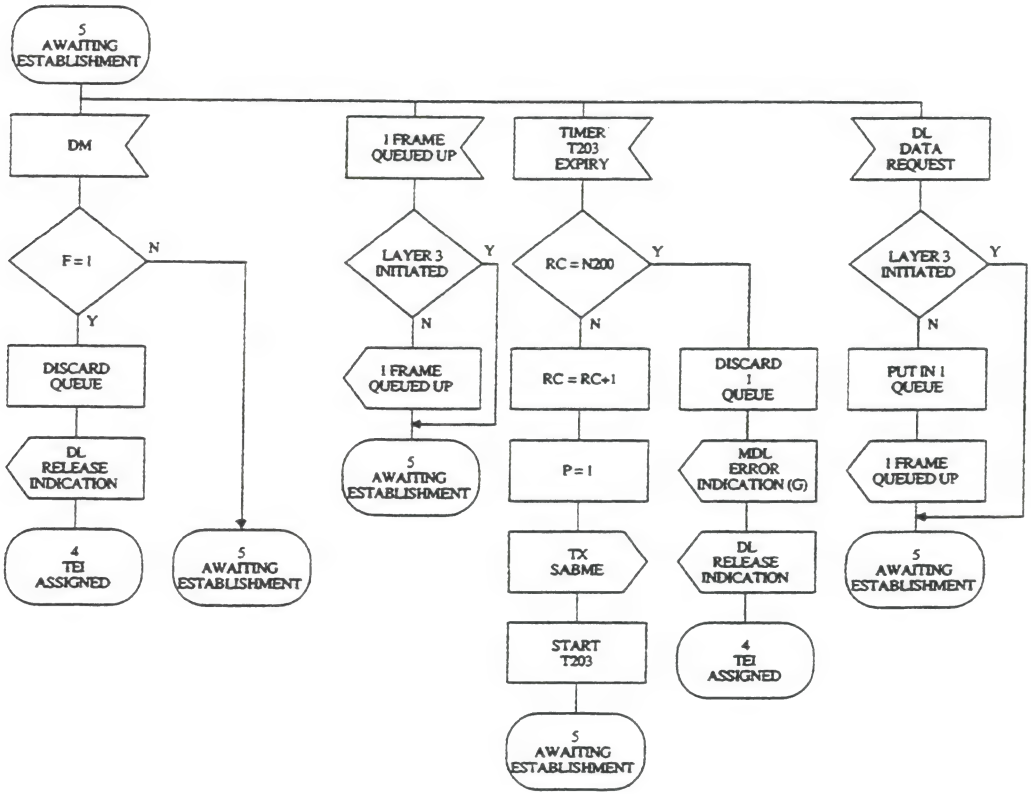


Figure 14

SDL Sequence Diagrams (Sheet 3 of 20)

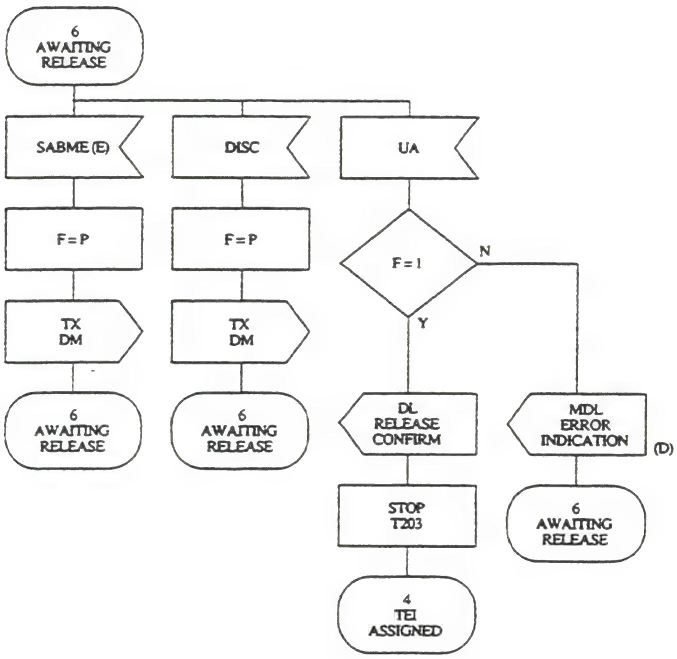


Figure 14
SDL Sequence Diagrams (Sheet 4 of 20)

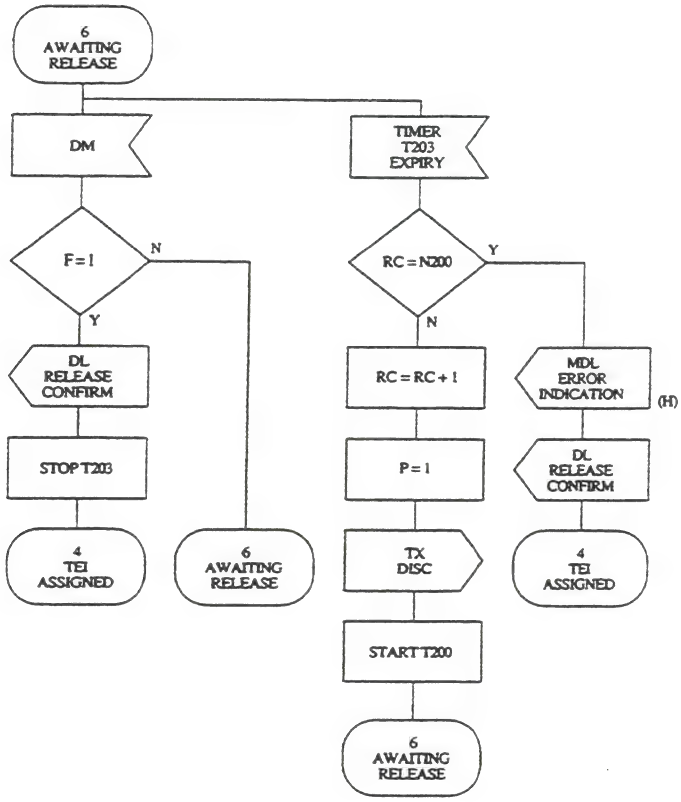


Figure 14

SDL Sequence Diagrams (Sheet 5 of 20)

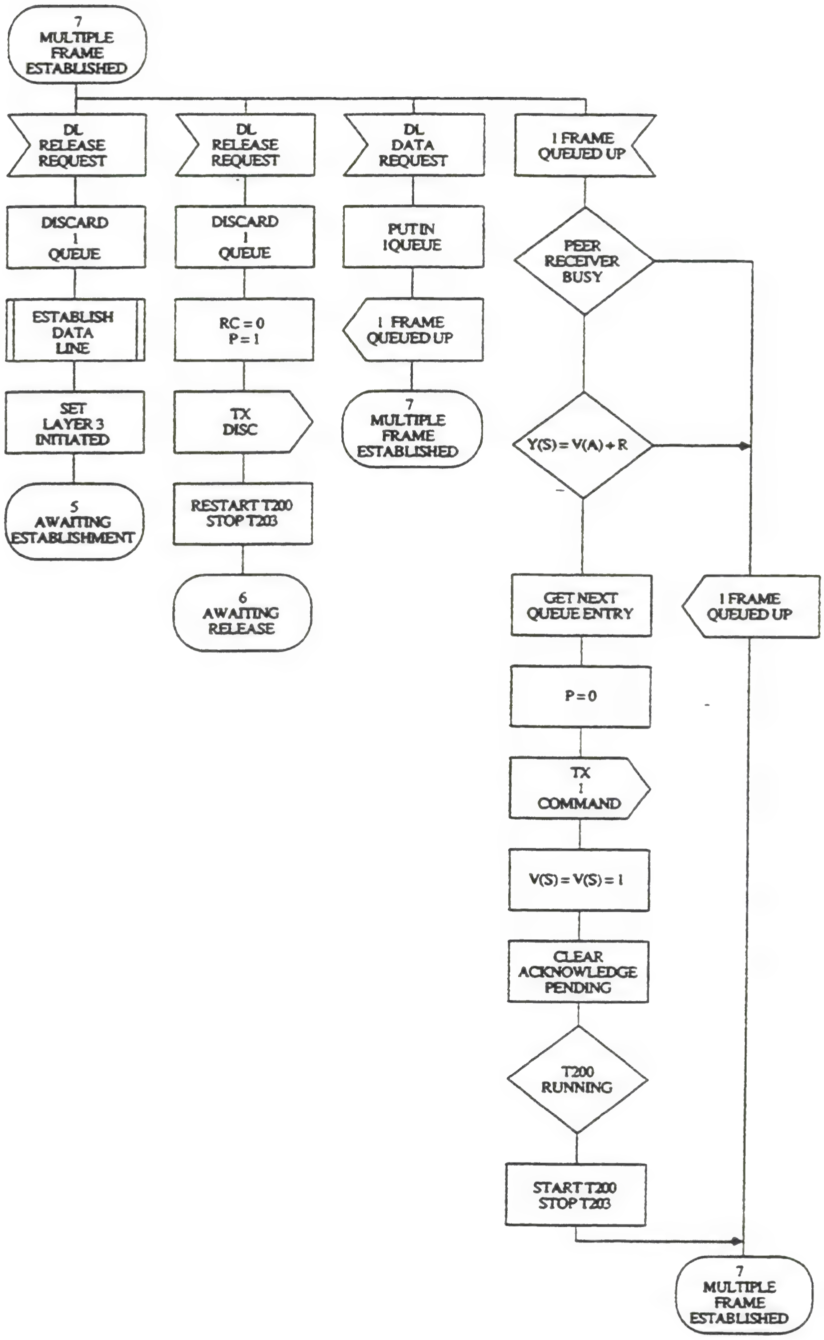


Figure 14

SDL Sequence Diagrams (Sheet 6 of 20)

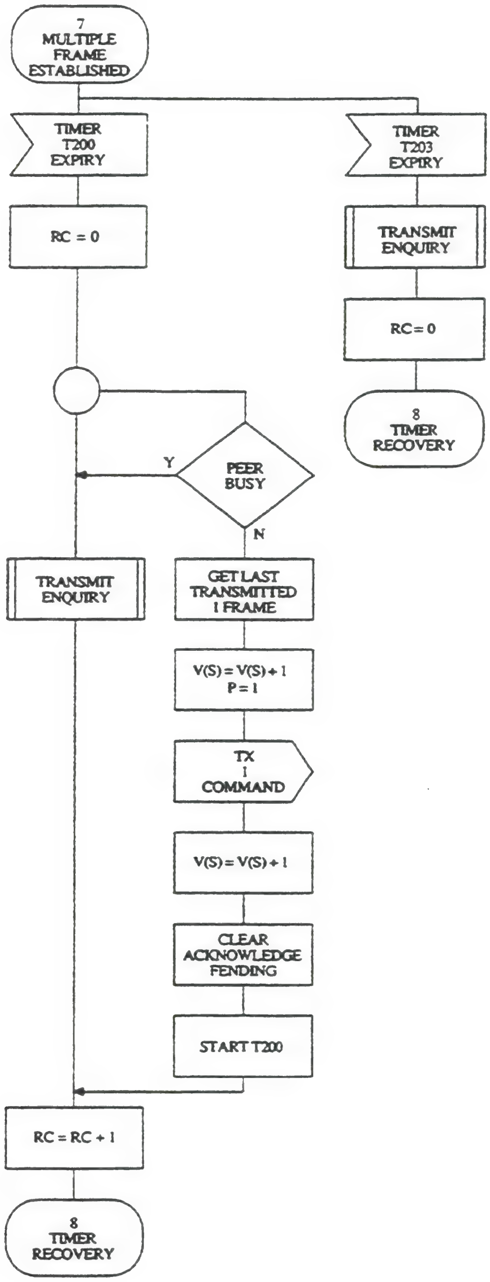
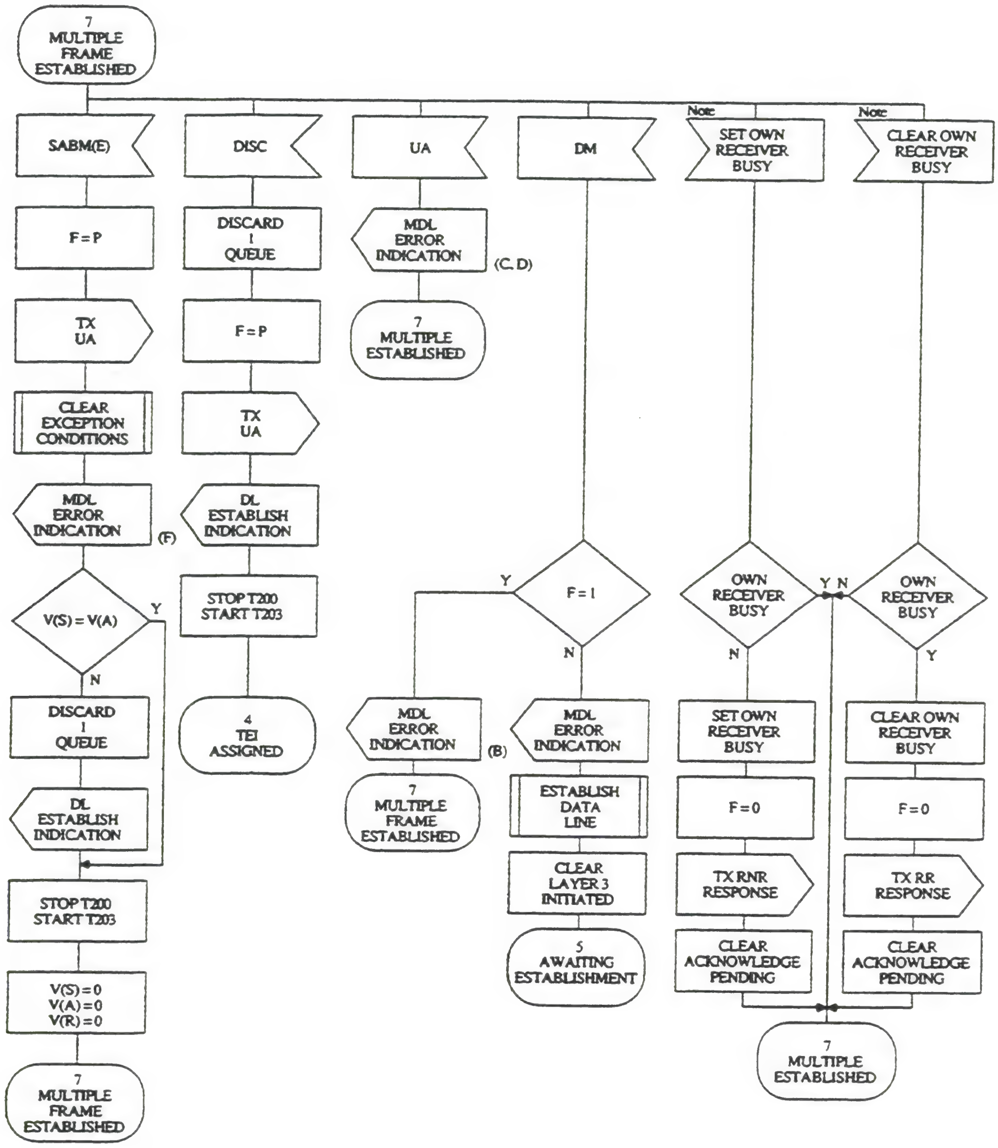


Figure 14

SDL Sequence Diagrams (Sheet 7 of 20)



Note: These signals are generated outside of this SDL representation, and may be generated by the connection management entity.

Figure 14

SDL Sequence Diagrams (Sheet 8 of 20)

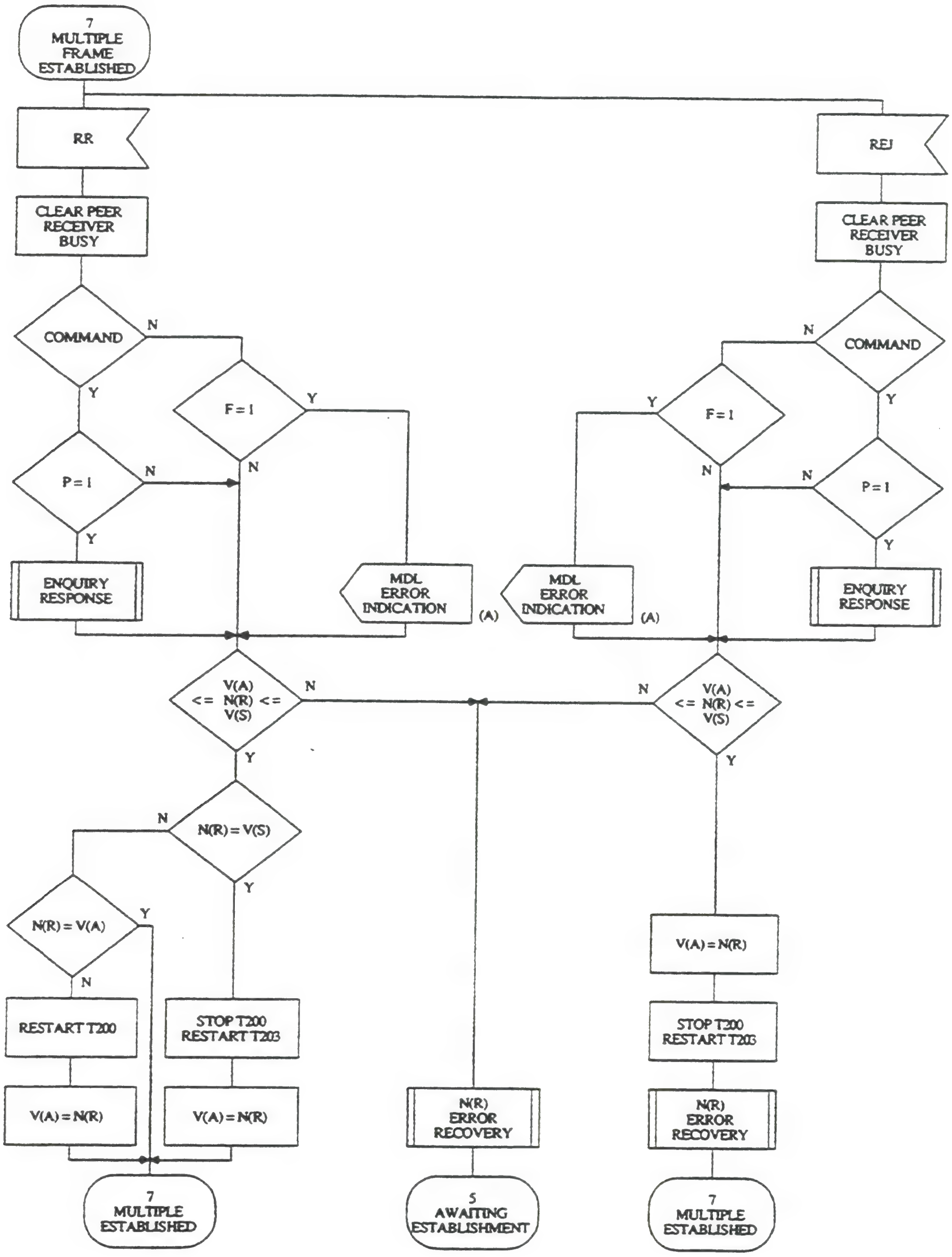


Figure 14

SDL Sequence Diagrams (Sheet 9 of 20)

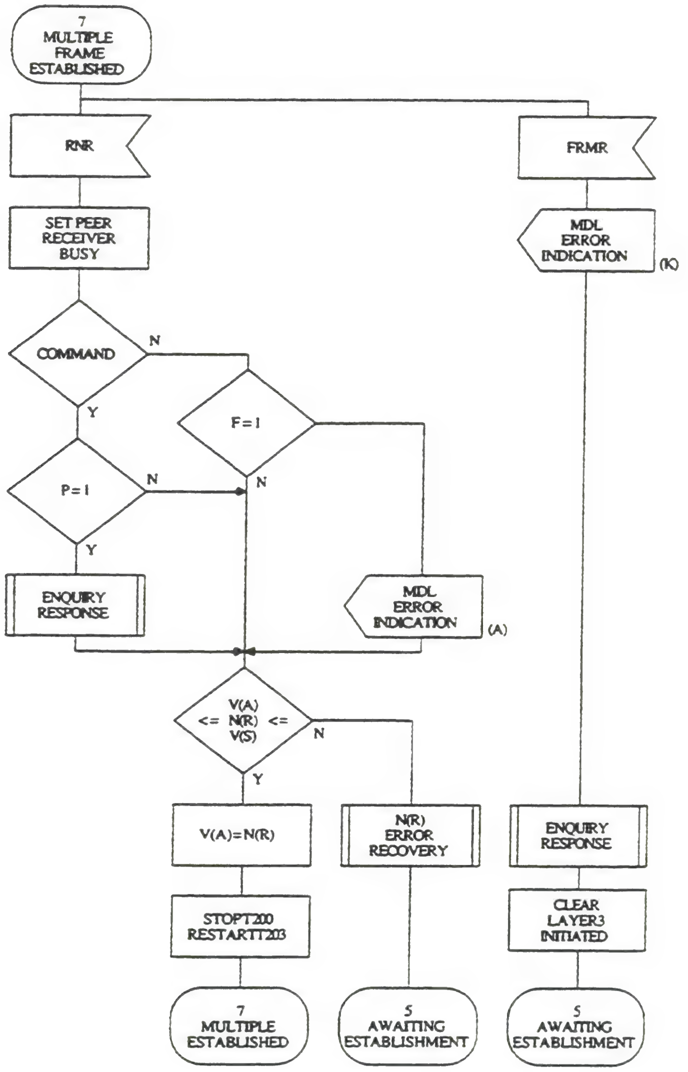


Figure 14

SDL Sequence Diagrams (Sheet 10 of 20)

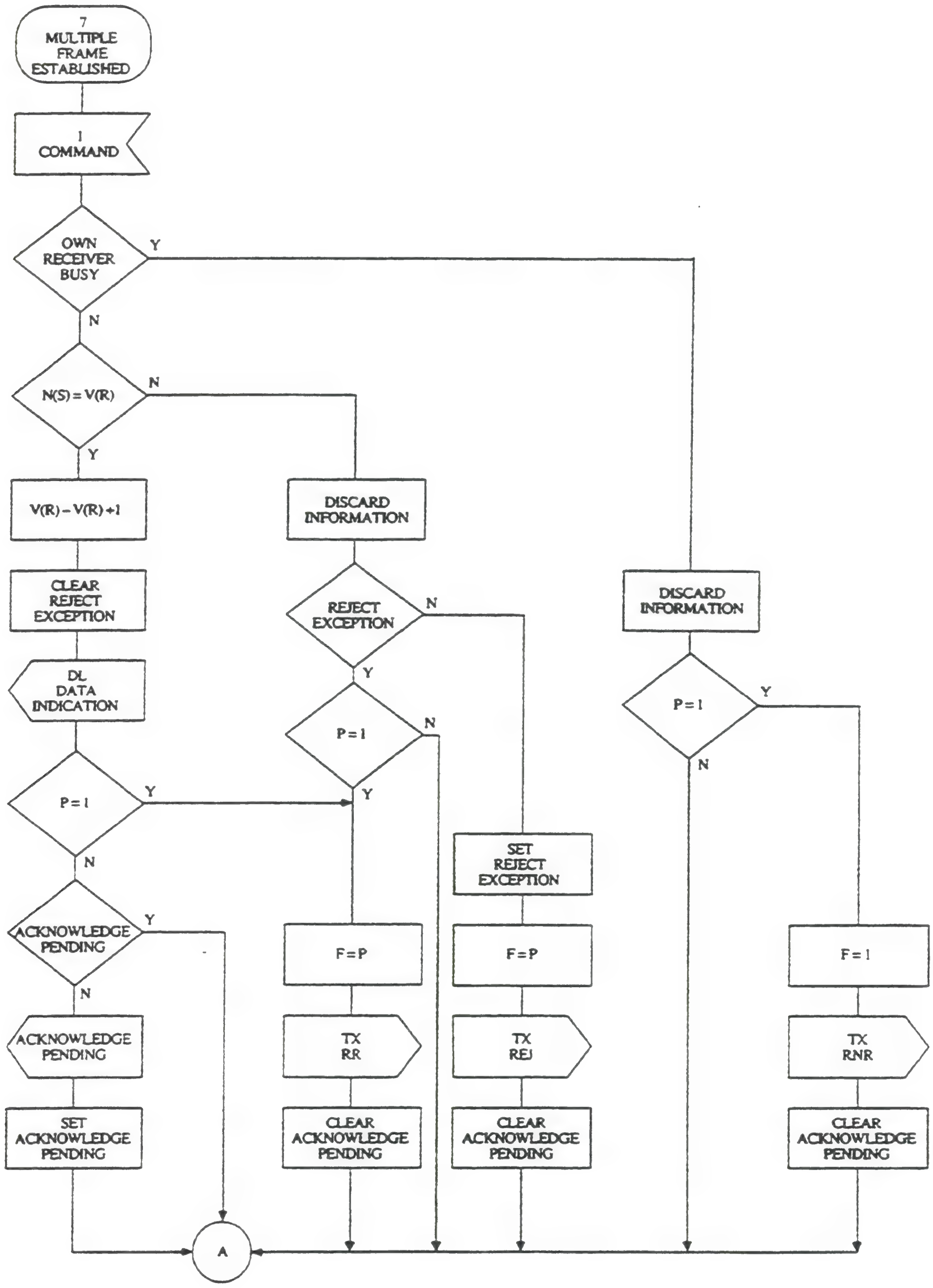


Figure 14

SDL Sequence Diagrams (Sheet 11 of 20)

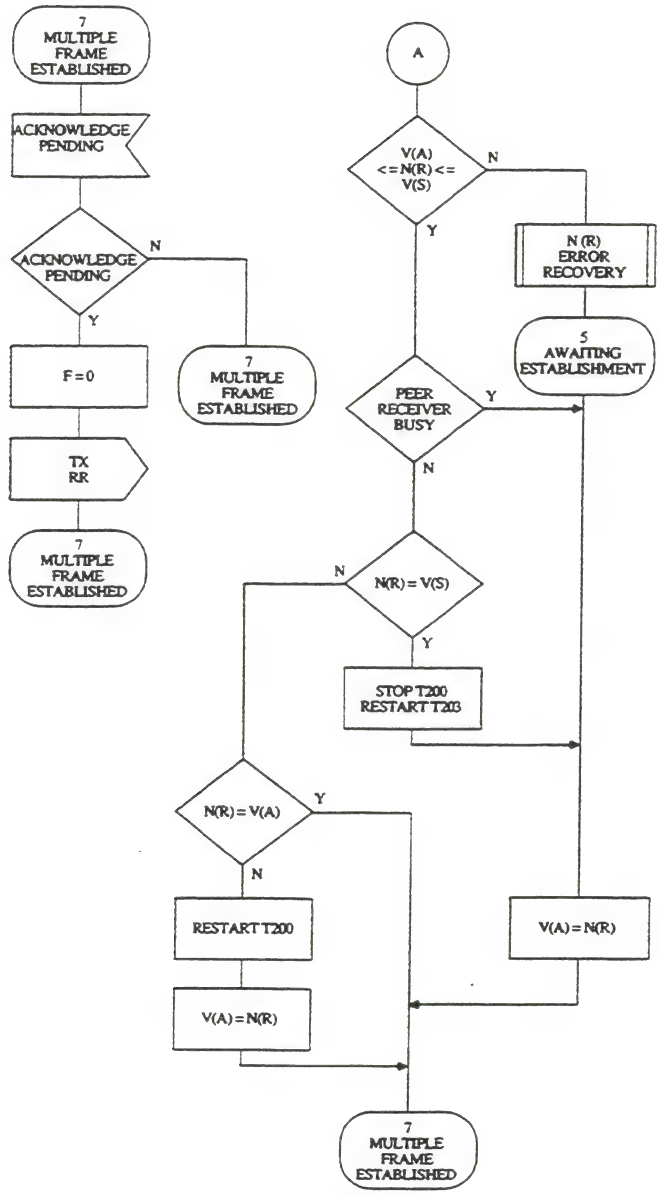


Figure 14

SDL Sequence Diagrams (Sheet 12 of 20)

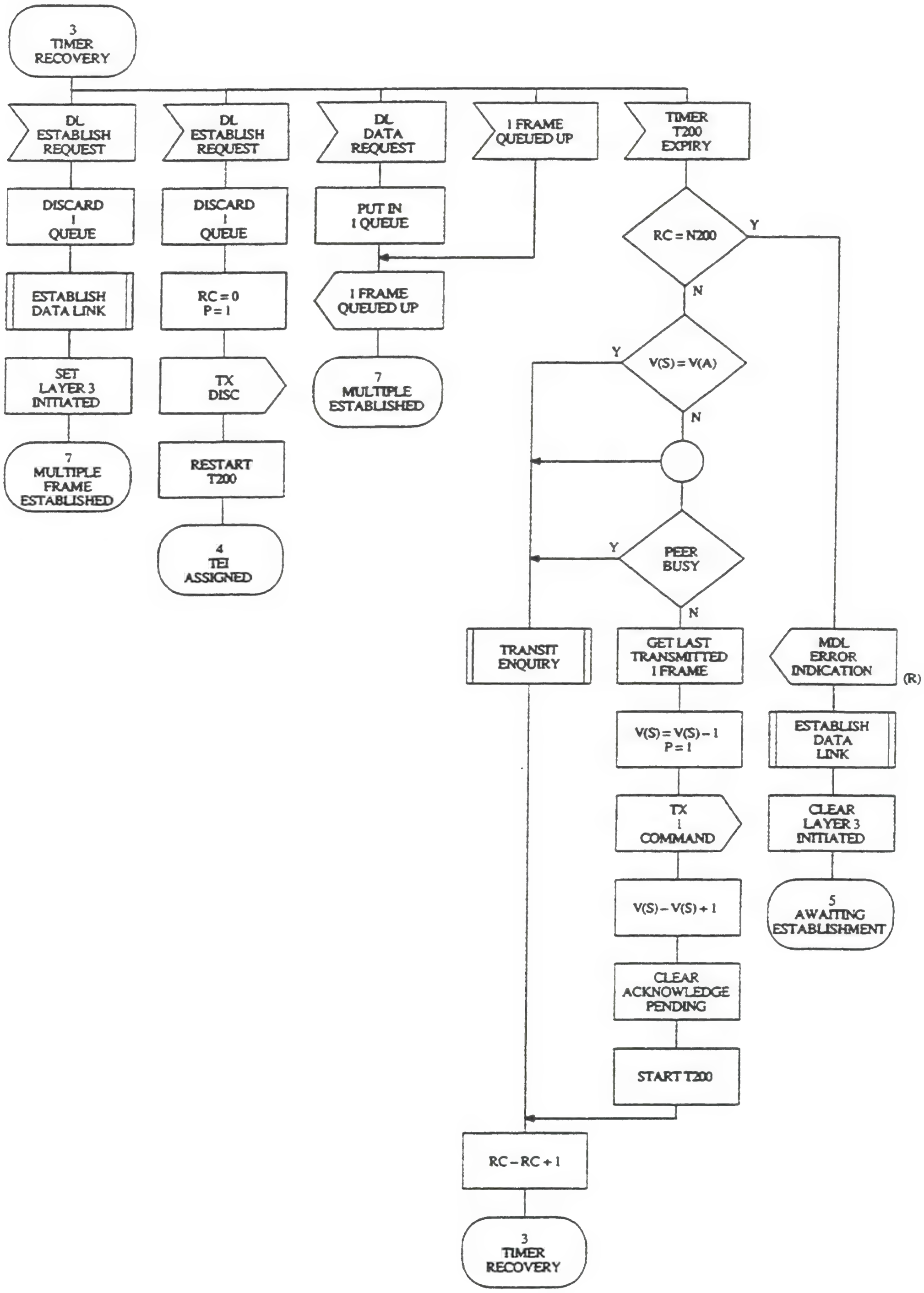
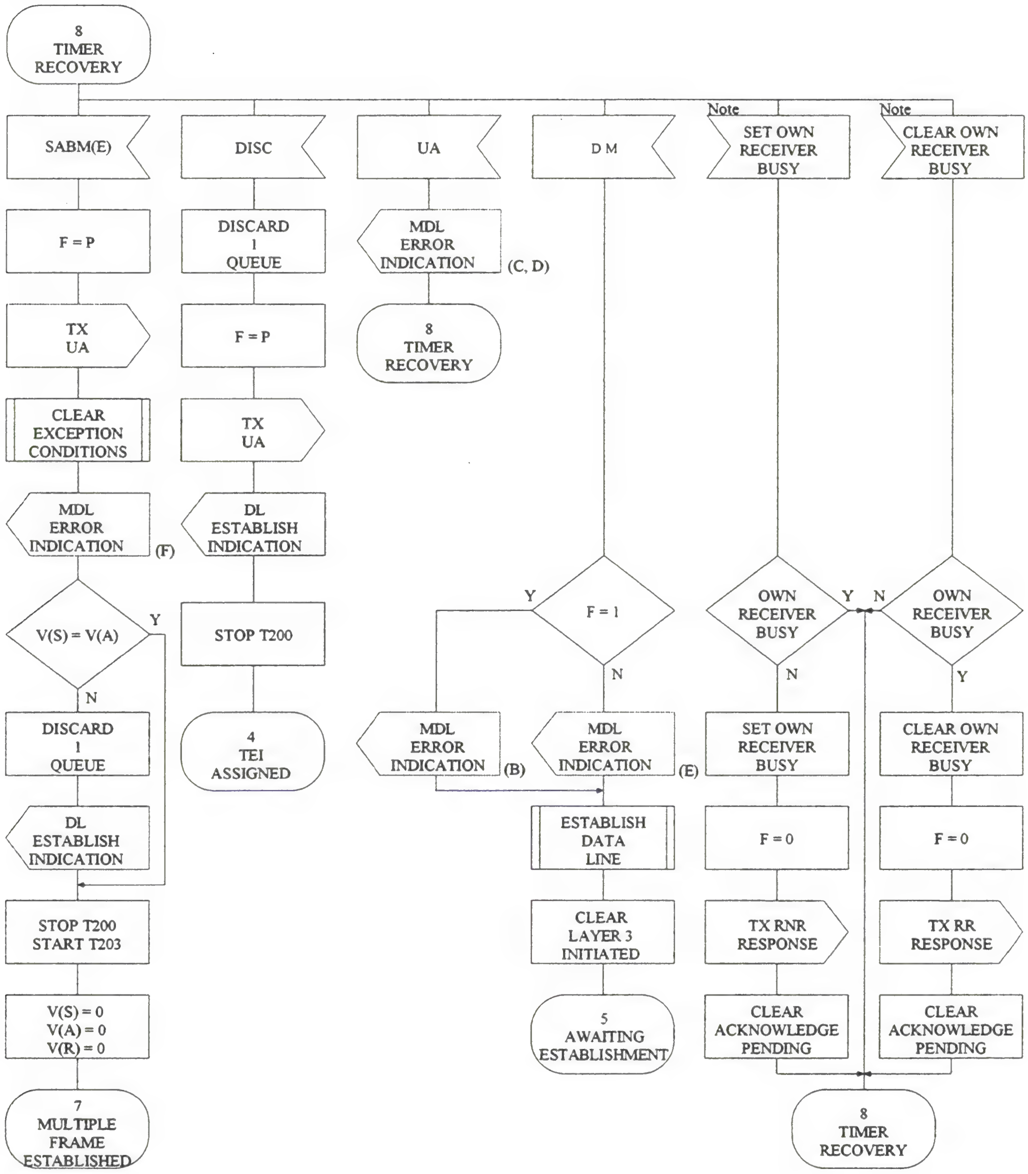


Figure 14

SDL Sequence Diagrams (Sheet 13 of 20)



Note: These signals are generated outside of this SDL representation, and may be generated by the connection management entity.

Figure 14

SDL Sequence Diagrams (Sheet 14 of 20)

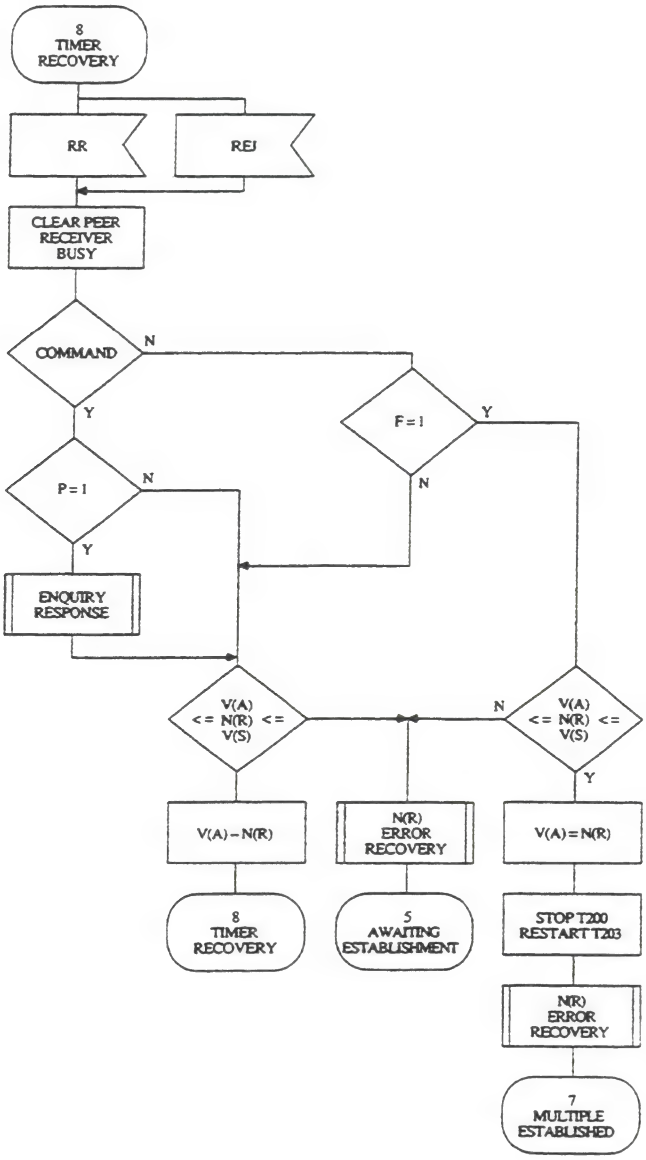


Figure 14

SDL Sequence Diagrams (Sheet 15 of 20)

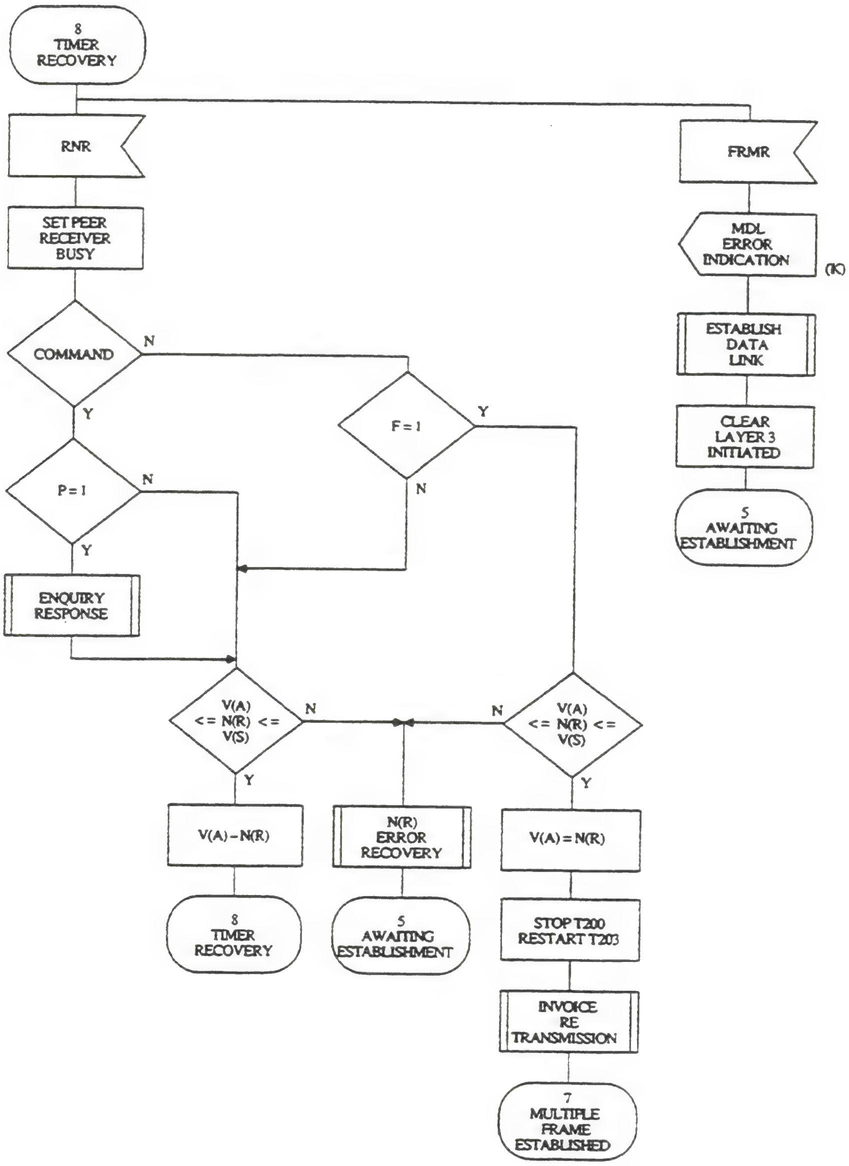


Figure 14

SDL Sequence Diagrams (Sheet 16 of 20)

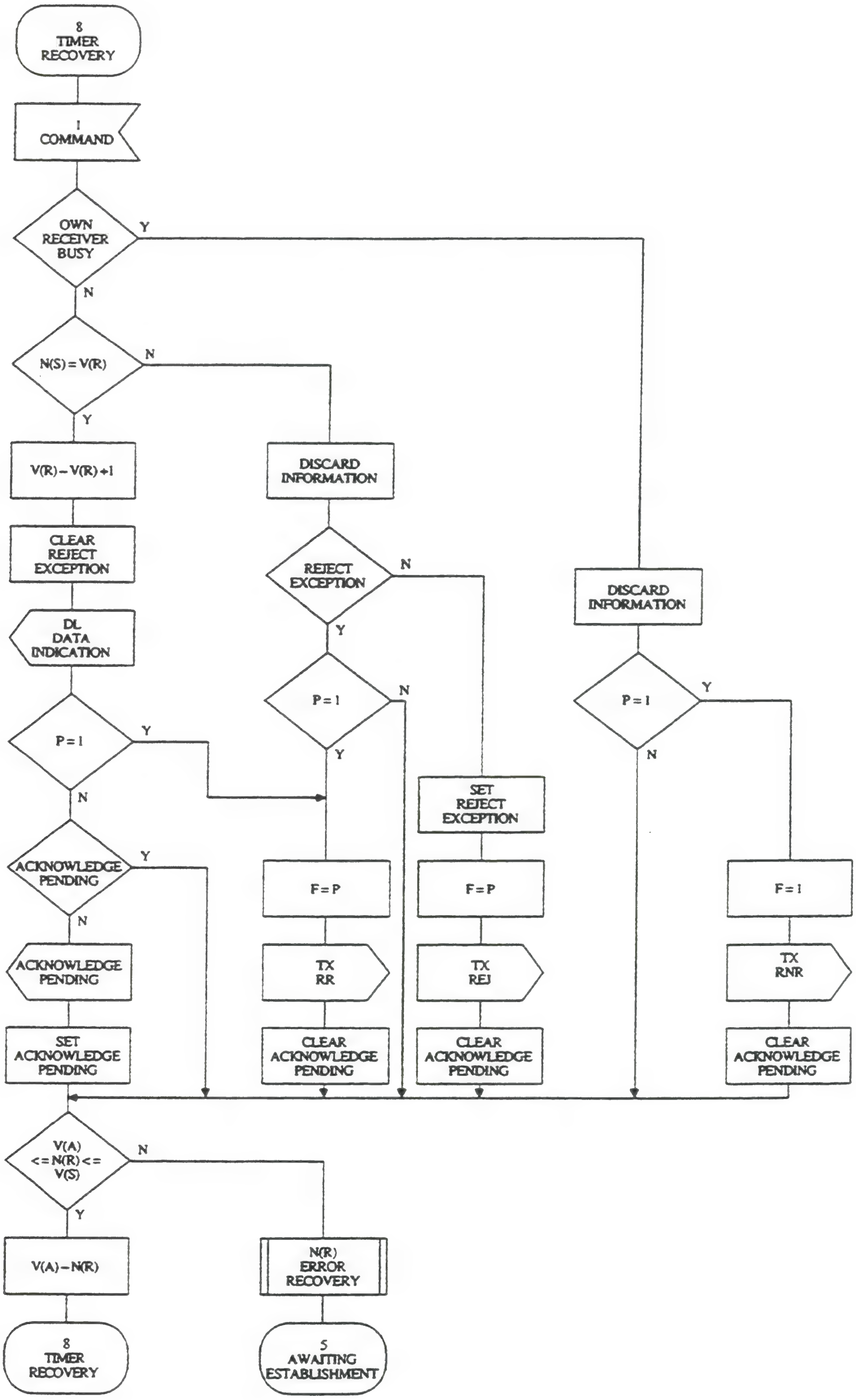
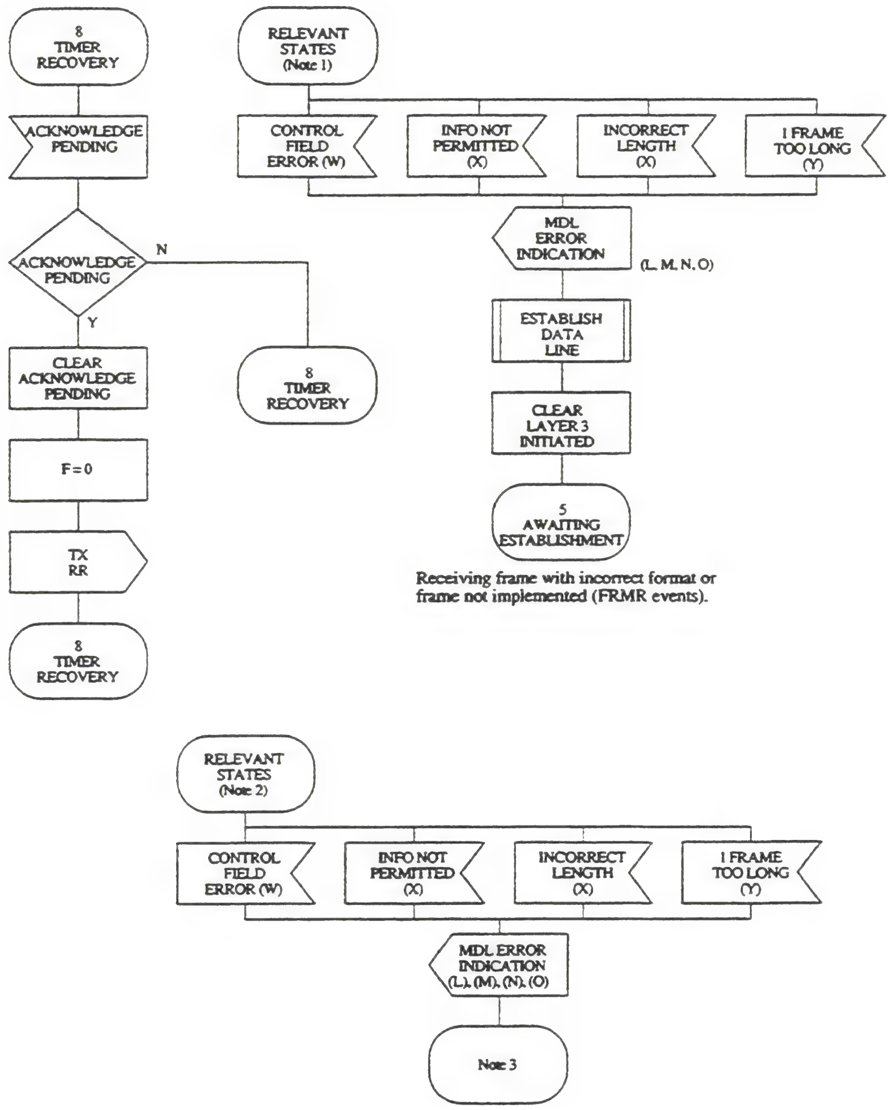


Figure 14

SDL Sequence Diagrams (Sheet 17 of 20)



Note 1: The relevant states are as follows:
7 Multiple-frame-established
8 Timer-recovery

Note 2: The relevant states are as follows:
4 TEI-assigned
5 Awaiting-establishment
6 Awaiting-release

Note 3: The data link layer returns to the state was in prior to the events shown.

Figure 14

SDL Sequence Diagrams (Sheet 18 of 20)

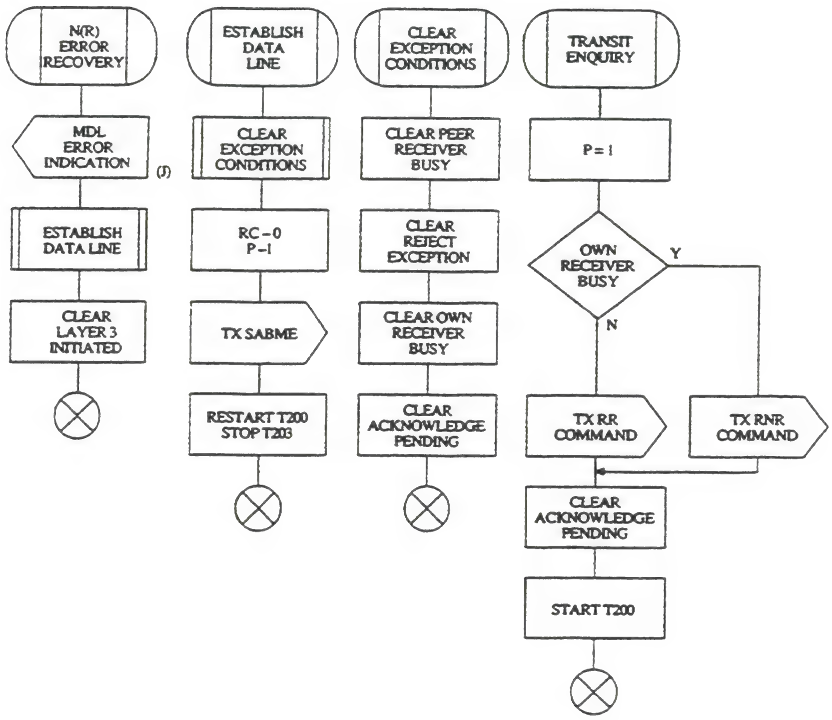
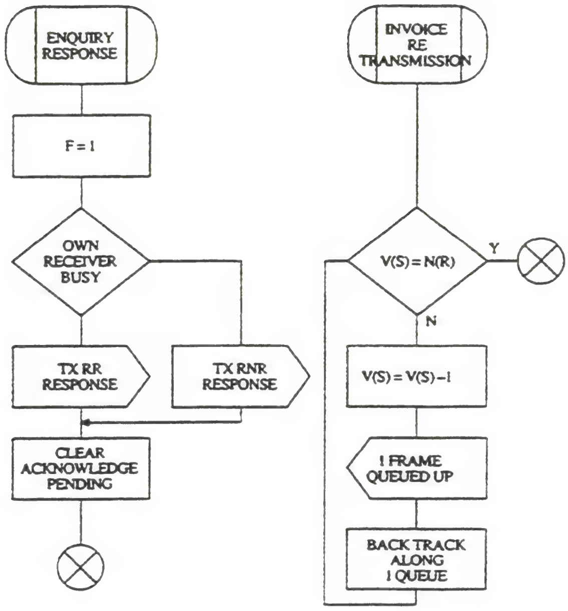


Figure 14

SDL Sequence Diagrams (Sheet 19 of 20)



Note: The generation of the correct number of signals in order to cause the required retransmission of I frames does not alter their sequence integrity.

Figure 14

SDL Sequence Diagrams (Sheet 20 of 20)

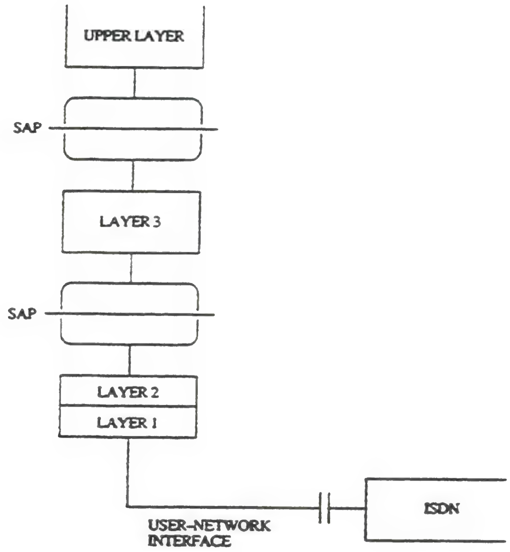
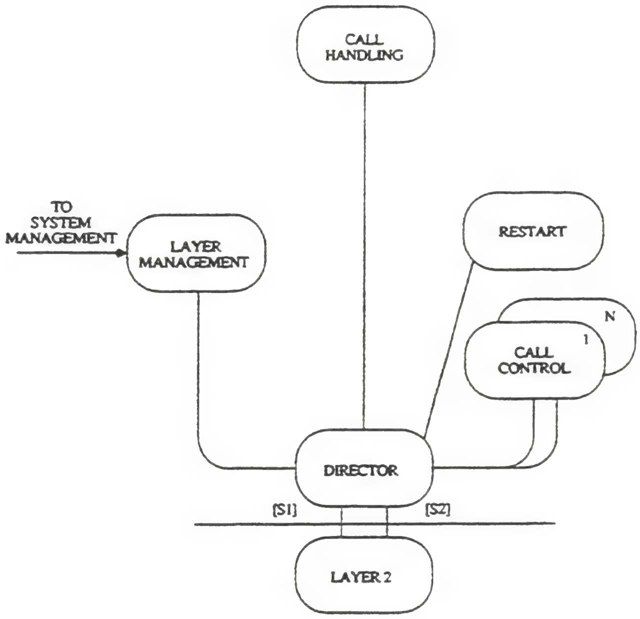


Figure 15

Overview of Interface Between
Layer 3 and Upper Layer



Signal lists for S1 and S2 are given in Clause 5.4.3.3.

Figure 16

Functional Model of Network Side Layer 3
(Process Interaction Diagram)

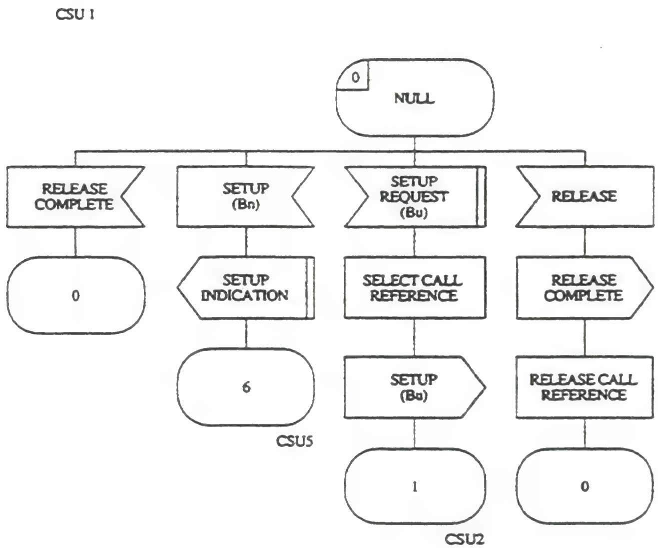


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 1 of 10)

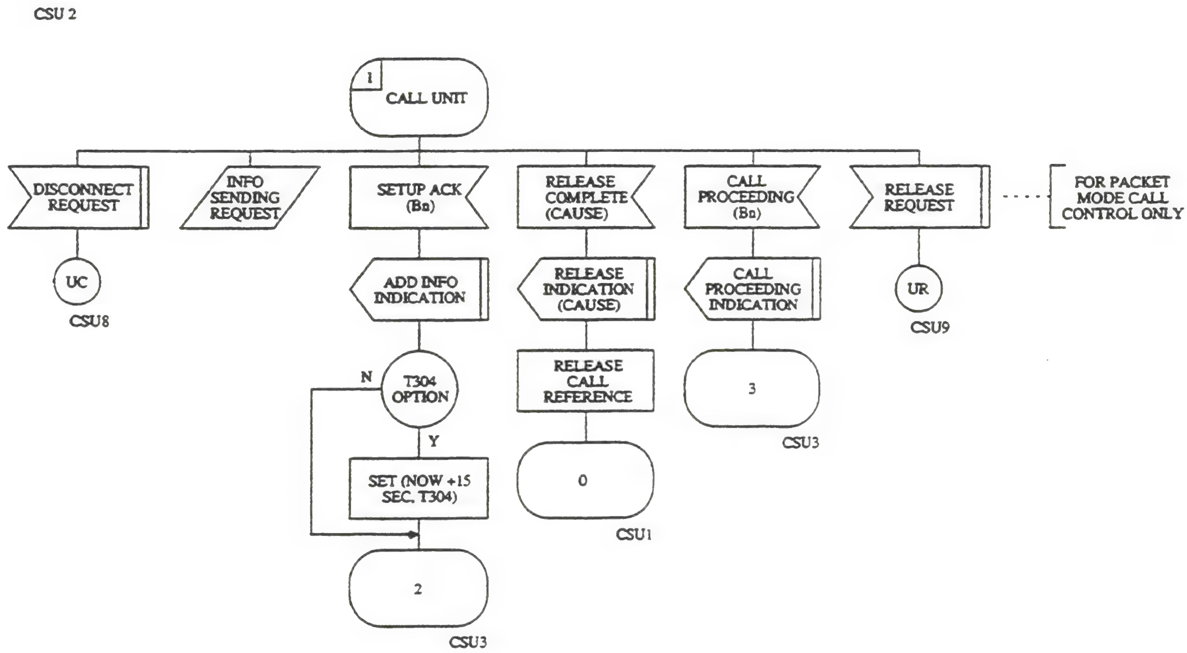
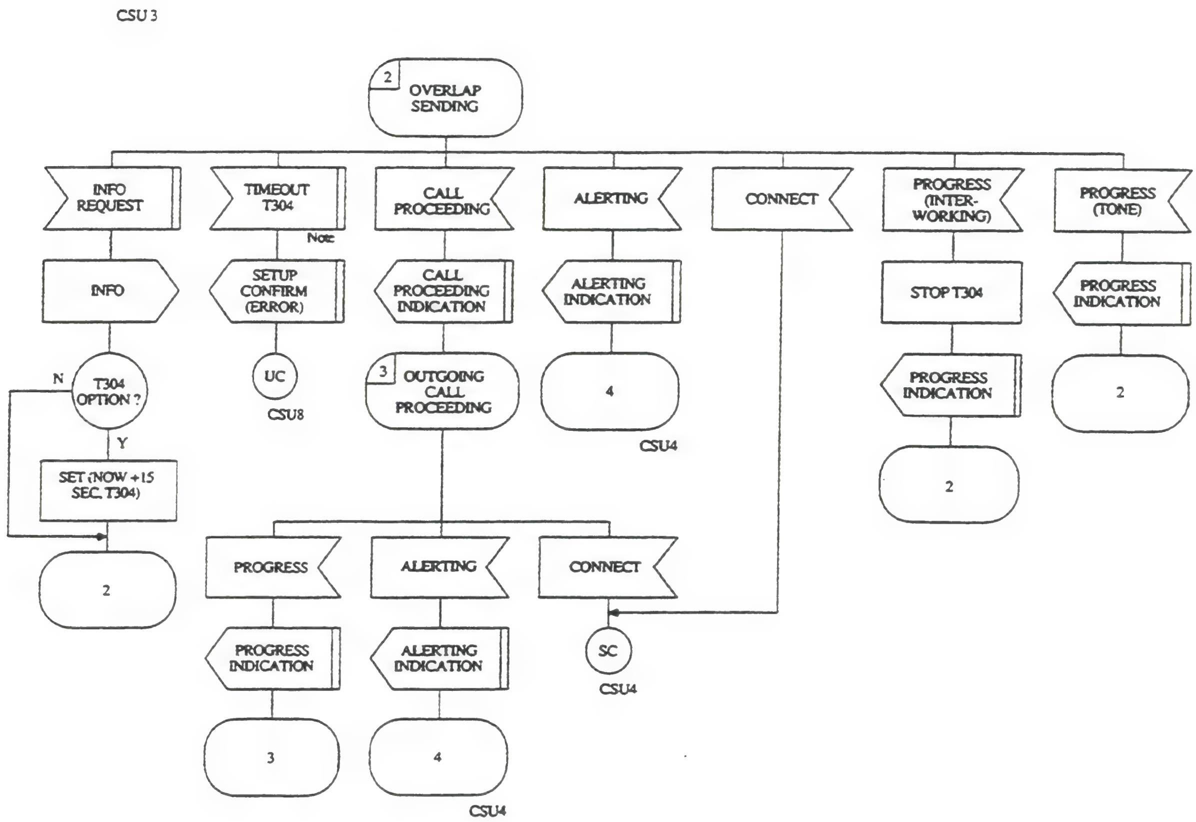


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 2 of 10)



Note: Only applicable if timer T304 option is selected.

Figure 17

Circuit Switched Call Control Procedures User Side (Sheet 3 of 10)

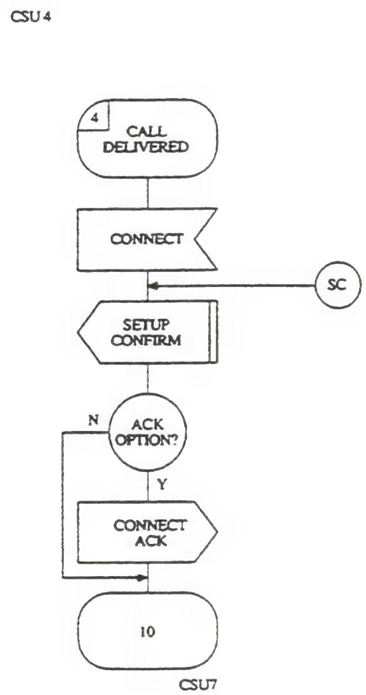


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 4 of 10)

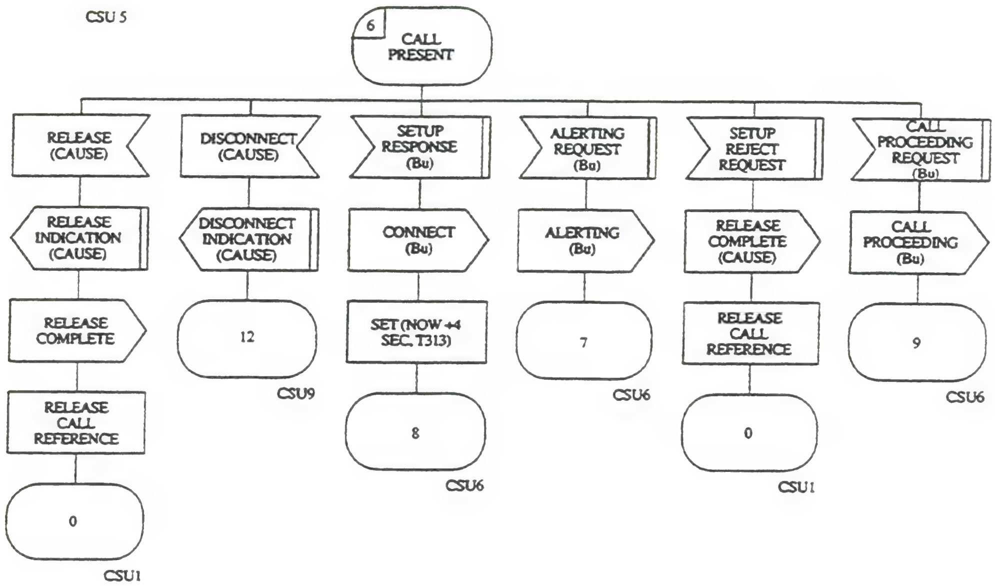


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 5 of 10)

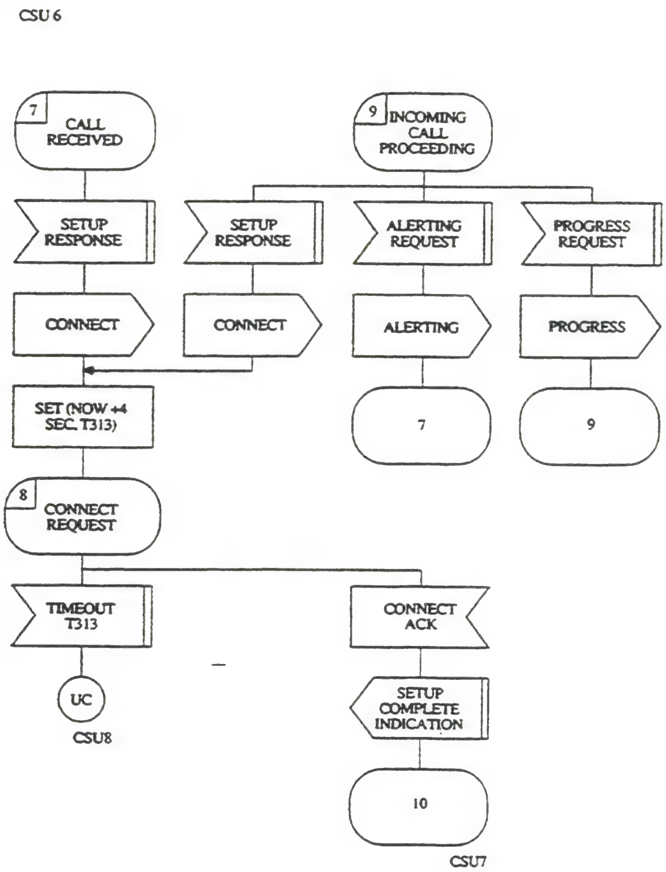


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 6 of 10)

CSU 7

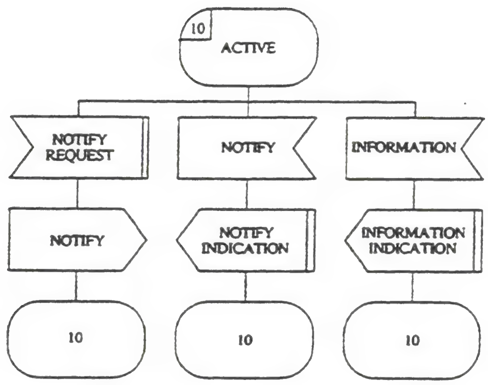


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 7 of 10)

CSU 8

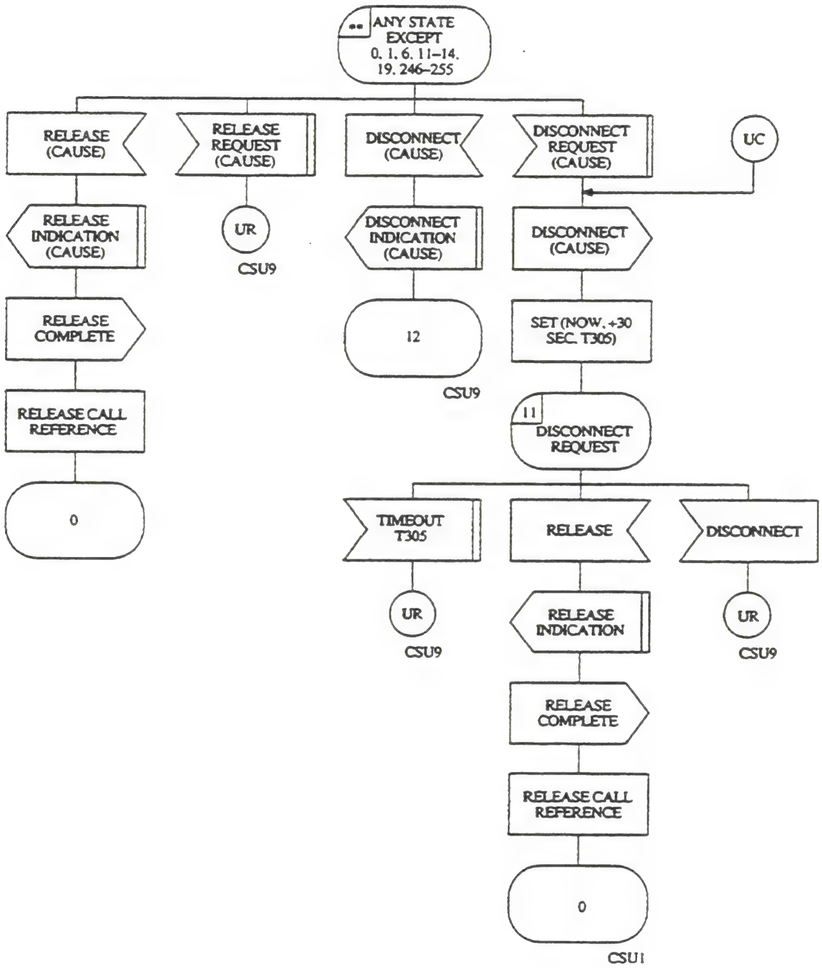


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 8 of 10)

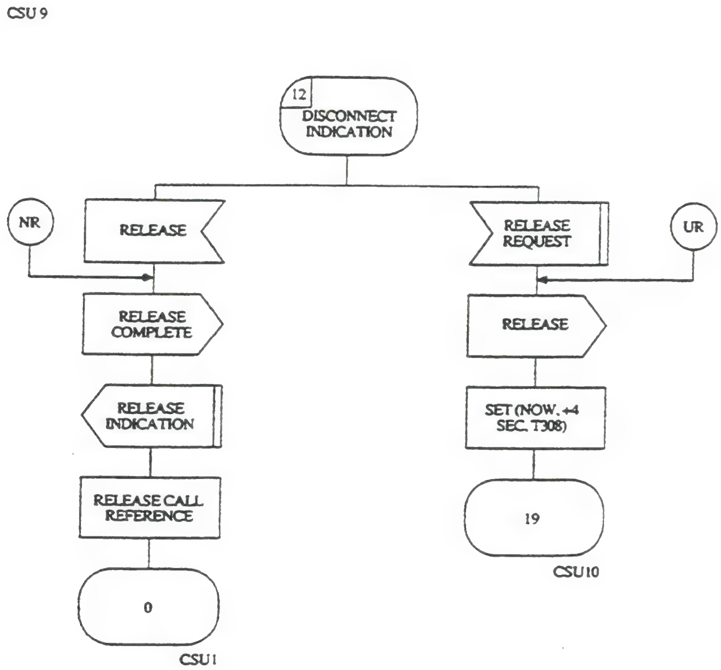
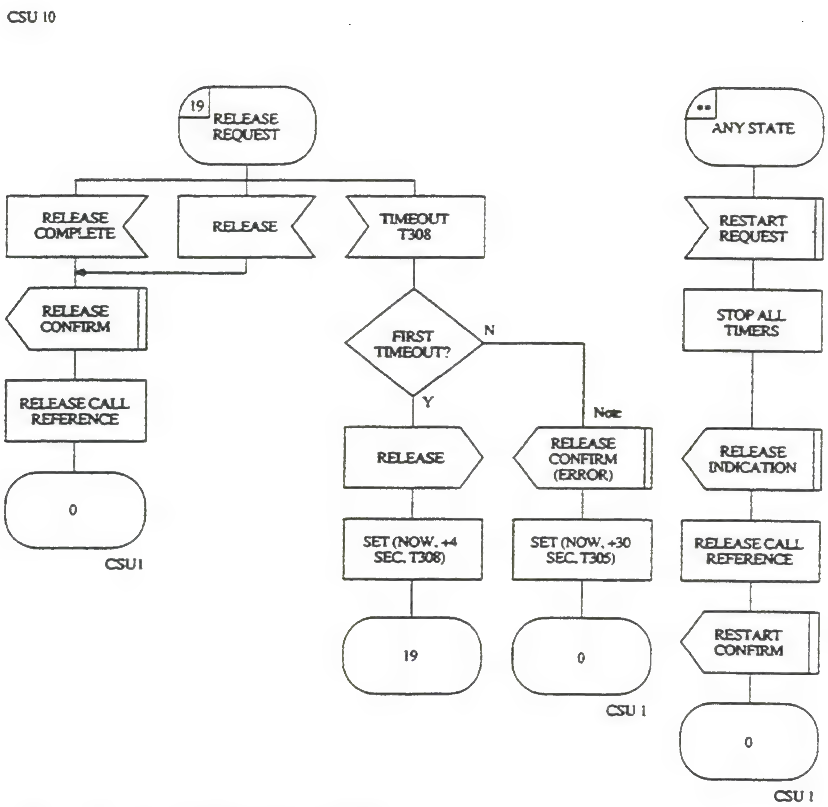


Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 9 of 10)



Note: If a channel is allocated this signal must initiate channel RESTART action.

Figure 17

Circuit Switched Call Control
Procedures User Side (Sheet 10 of 10)

CSUSTAT

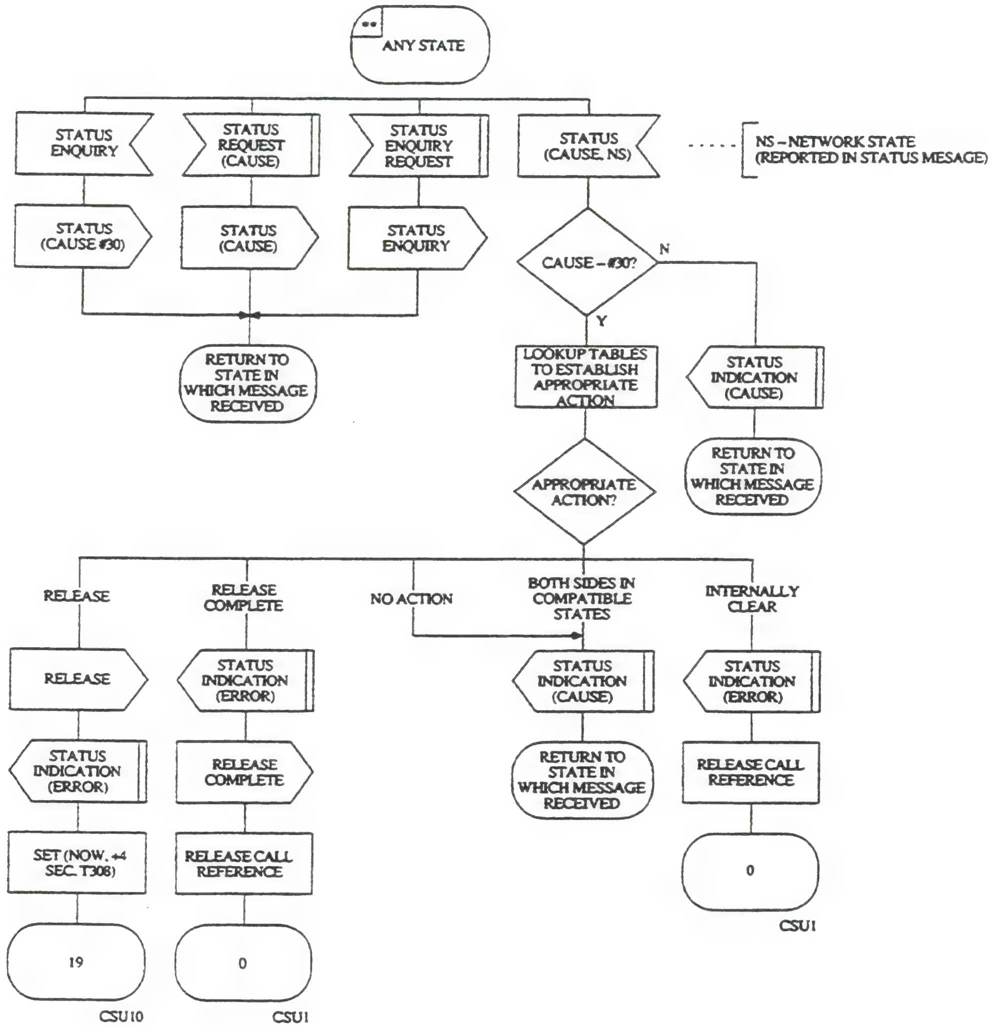
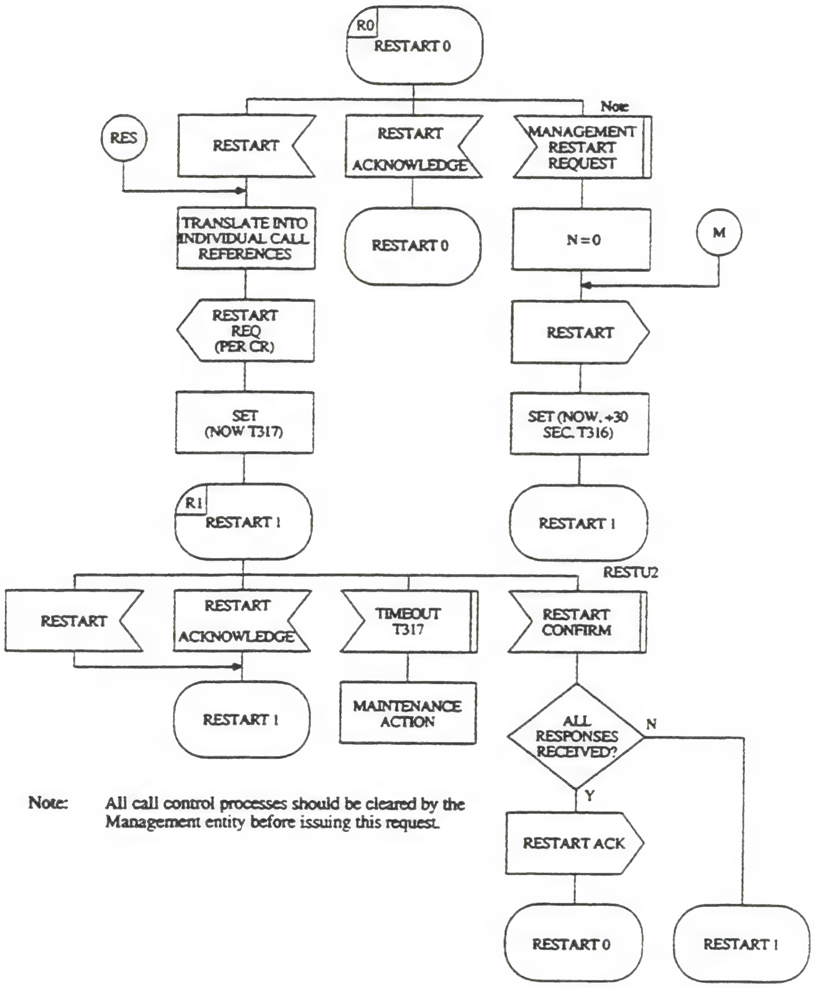


Figure 18

Circuit Switched User Side Status

RESTU1



Note: All call control processes should be cleared by the Management entity before issuing this request.

Figure 19

Restart Procedures User Side (Sheet 1 of 2)

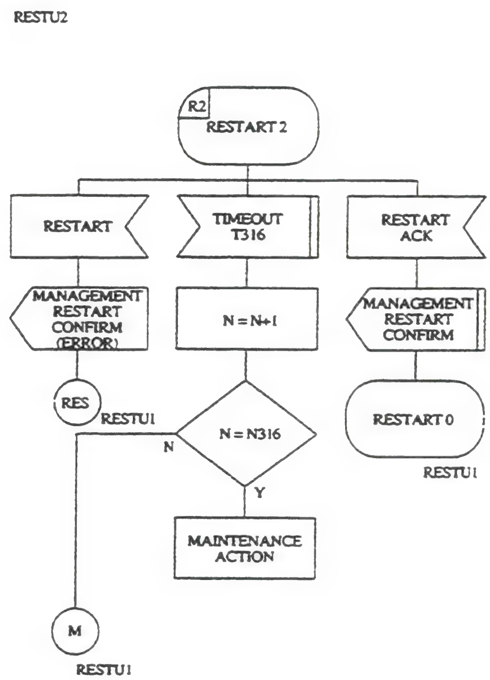


Figure 19

Restart Procedures User Side (Sheet 2 of 2)

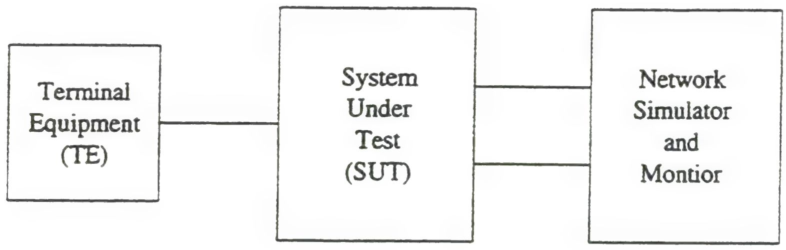


Figure 20

Layer 3 Network Simulator Test Set–Up

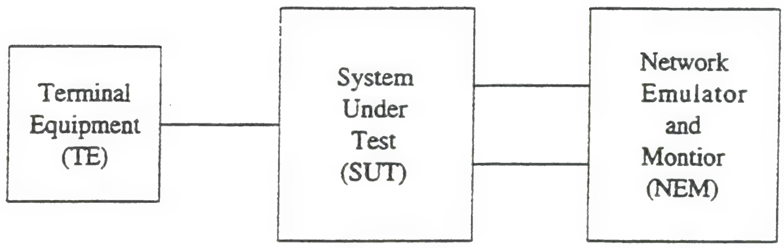


Figure 21

Layer 3 Network Emulation Test Set–Up

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[2] Technical Standard 004 — Voice Frequency Performance Requirements for Customer Equipment

[3] Technical Standard 008 — Requirement for Authorised Cabling Products

[4] Technical Standard 016 — General Requirements for Customer Equipment Connected to Hierarchical Digital Interfaces

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[5] AS 1000—1979 — The International System of Units (SI) and its application

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[33]	I.411: 1993	ISDN user network interfaces – Reference configurations
[34]	I.412: 1988	ISDN user network interfaces, interface structure and access capabilities

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[37]	I.441 (Q.921): 1988	ISDN user–network interface, data link layer – specification
[38]	I.450 (Q.930): 1988	ISDN user–network interface layer 3 – General aspects
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